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Economic Analysis of the Final Effluent Limitations Guidelines and Standards for the Iron & Steel Manufacturing Point Source Category

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Economic Analysis of Final Effluent Limitations Guidelines and Standards for the Iron and Steel Industry

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ES.1 BACKGROUND

The U.S. Environmental Protection Agency (EPA) is promulgating effluent limitations guidelines and standards for cokemaking, sintering and other subcategories in the iron and steel manufacturing point source category. EPA is proposing Best Practicable Control Technology Currently Available (BPT), Best Available Technology Economically Achievable (BAT), Pretreatment Standards for Existing Sources (PSES), New Source Performance Standards (NSPS), and Pretreatment Standards for New Sources (PSNS). This Economic Analysis (EA) summarizes the costs and economic impacts of technologies that form the bases for setting limits and standards for the iron and steel industry.[1]

ES.2 INDUSTRY OVERVIEW

The United States is the third largest steel producer in the world with 12 percent of the market, an annual output between 100 and 115 million tons per year, and nearly 150,000 employees. Major markets for steel are service centers and the automotive and construction industries. A service center is an operation that buys finished steel, processes it in some way, and then sells it. Together these three markets account for about 61 percent of steel shipments. The remaining 39 percent is dispersed over a wide range of products and activities, such as agricultural, industrial, and electrical machinery; cans and barrels; and appliances. The building of ships, aircraft, and railways and other forms of transport are included in this group as well.

The iron and steel effluent guideline would apply to approximately 254 iron and steel sites. Of these 254 sites, approximately 211 can be analyzed for post-regulatory compliance impacts at the site level. Based on EPA survey data (see next section), the 254 sites are owned by 115 companies and approximately 60 sites are owned by small business entities. The global nature of the industry is illustrated

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[1]The industry, however, is free to use whatever technology it chooses in order to meet the limit.

by the fact that 18 companies have foreign ownership. Twelve other companies are joint entities with at least one U.S. company partner. Excluding joint entities and foreign ownership, the data base contains 85 U.S. companies, more than half of which are privately owned. Responses to the EPA survey are the only sources of financial information for these privately-held firms.

The EPA survey collected financial data for the 1995-1997 time period (the most recent data available at the time of the survey). This three-year time frame marks a period of high exports (six to eight million tons per year). This high point in the business cycle allowed companies to replenish retained earnings, retire debt, and take other steps to reflect this prosperity in their financial statements. Even so, an initial analysis of the pre-regulatory condition of companies in the EPA survey indicated that twenty-seven of them would be considered "financially distressed" for reasons ranging from start-up companies and joint ventures to established firms that still showed losses.

The financial situation changed dramatically between 1997 and 1998 due to the Asian financial crisis and slow economic growth in Eastern Europe. When these countries' currencies fell in value, their steel products fell in price relative to U.S. producers. While the U.S. is and has been the world's largest steel importer (and a net importer for the last two decades), the U.S. was nearly the only viable steel market to which other countries could export during 1998. Imports reached a high of 54.3 million tons in 1998 and high levels of imports persisted in 1999 and 2000, with 49.3 million tons and 52.2 million tons, respectively. At least partly due to increased competition from foreign steel mills, the financial health of the domestic iron and steel industry also experienced a steep decline after 1997. This decline is not reflected in the survey responses to the questionnaire, which covered the years 1995 through 1997 and which were the most recent data available at the time EPA administered the questionnaire in 1998. This decline, however, is incorporated in four of the five forecasting models, see Section ES.4.

ES.3 DATA SOURCES

EPA used its authority under Section 308 of the Clean Water Act to collect information not available otherwise, such as site-specific data, and financial information for privately-held firms and joint entities (called the *Collection of 1997 Iron and Steel Industry Data* or the "EPA Survey"). EPA could not use Census or industry data, such as the American Iron and Steel Institute's annual statistics because both sources contain data for a mix of sites in two EPA categories: (1) iron and steel and (2) metal products and machinery. Hence, the survey is the only source for information crucial to the rulemaking process. Particularly for the post-1997 period, EPA supplemented the survey information with sources such as trade journal reports, Security and Exchange Commission filings, and trade case filings with the U.S. Department of Commerce and the U.S. International Trade Commission.

ES.4 ECONOMIC IMPACT METHODOLOGY

EPA considered nine major components for the Economic Analysis:

an assessment of the number of facilities that this rule could affect;

an estimate of the annualized aggregate cost for these facilities to comply with the rule using site-level capital, one-time non-capital, and annual operating and maintenance (O&M) costs;

a site-level closure analysis to evaluate the impacts of compliance costs for operations in individual subcategories at the site;

a second site-level closure analysis to evaluate the impacts of the combined cost of the options for all subcategories at the site;

an evaluation of the corporate financial distress incurred by the companies in the industry as a result of combined compliance costs for all sites owned by the company;

an industry-wide market analysis of the impacts of the compliance costs;

an evaluation of secondary impacts such as those on employment and economic output;

an analysis of the effects of compliance costs on small entities; and

a cost-benefit analysis pursuant to E.O. 12866.

The industry profile provides an estimate of the 254 sites potentially affected by the regulation.

A starting point for the rest of the economic analysis is a cost annualization model that calculates the present value and annualized cost of the capital, one-time non-capital, and operating and maintenance costs associated with each option for improved waste water treatment. The model incorporates company-specific cost of capital (discount rates) and tax rates. Tax shields are calculated according to IRS rules. The subcategory, site, company, and industry analyses use the cost outputs from the annualization model.

EPA developed a site closure model in which a site was considered closed as a result of the regulation if it showed a neutral to positive present value of future cash flows before the regulation and a negative value after the regulation. At proposal, EPA analyzed three forecasting methods, two of which specifically addressed the post-1997 industry downturn and cyclicality in the industry. All methods incorporate a “no-real-growth assumption.” In response to comments and new data submitted in response to the proposed rule, EPA (1) added two more forecasting methods that incorporated current industry conditions (i.e., for the final rule, EPA analyzed five forecasting methods, four of which specifically address the industry downturn), and (2) incorporated updated financial information for those sites and companies that submitted them. For the **subcategory** analysis, EPA ran the closure model with only the subcategory costs. For the **site** analysis, EPA aggregated the costs for upgrading all operations in all subcategories at the site and ran the closure model.

EPA reviewed the last ten years of economic literature to evaluate methods of identifying **corporate** financial distress and chose the Altman Z’-score model (a weighted average of financial ratios). EPA calculates the Z’-score for each company with the 1997 survey data to estimate pre-regulatory conditions. EPA recalculates the Z’-score after incorporating the effects of the pollution control costs into the balance sheet and income statement. All companies whose Z’-score changes from “good” or “indeterminate” in the pre-regulatory analysis to “distressed” in the post-regulatory analysis are considered to bear an impact.

Every projected closure has direct impacts on lost employment and output. These direct impacts have repercussions throughout the rest of the economy. The U.S. Commerce Department maintains an input-output model of the national economy. EPA uses the input-output multipliers for the iron and steel industry with the direct impacts to evaluate **secondary impacts** on the nation’s economy as a whole. EPA used county or metropolitan statistical area unemployment data to examine the **regional** effects of each projected site closure.

EPA investigated the industry-wide **market and trade** effects of the regulation. EPA performed a 3-stage non-linear least-squares econometric estimation of a single-product translog cost model based on 20 years of U.S. Census and industry data. The market supply relationship is derived from the cost function and accounts for the effect of imperfect competition in the steel market. The model also incorporates international trade. The model estimates the supply shift, and the resulting changes in: domestic price, domestic consumption, export demand, and import supply. The model results may be used to estimate a "cost pass-through" factor indicating the portion of the increased cost that the iron and steel industry can pass through to the customers.

ES.5 RESULTS

ES.5.1 Regulatory Options and Costs

Table ES-1 summarizes the pollution control options selected for final promulgation while Table ES-2 lists the associated costs. Table ES-3 presents the costs for the final rule in both 1997 dollars and 2001 dollars to allow the reader to tie the EA (1997 dollars) with the preamble to the rule (2001 dollars). The rule has an estimated pre-tax annualized cost of $11 million (1997 dollars).

ES.5.2 Impacts

For the promulgated rule, EPA projects:

- no site closures due to subcategory costs
- no site closures due to aggregated subcategory costs for all operations at a site
- no company moves into financial distress

Table ES-1

Description of Regulatory Options by Subcategory

Subcategory	Discharge Status	Regulatory Option	Description of Regulatory Option
Cokemaking	Direct	BAT 1	# Tar/oil removal, ammonia stripping, and biological treatment with clarification # Liquid/solid separation and heat exchanger
	Indirect	PSES 1	# Tar/oil removal, equalization, and ammonia stripping
Sintering	Direct	BAT 1	# Solids removal, high rate recycle, metals precipitation, alkaline chlorination, and mixed-media filtration for blowdown wastewater
	Indirect	PSES 1	# Same as BAT 1
Other Operations	Direct	BAT 1 (DRI)	# Solids removal, clarifier, sludge dewatering, and high rate recycle # Filtration for blowdown wastewater
		BAT 1 (Forging)	# High rate recycle, oil/water separator for blowdown wastewater, and mixed-media filtration

Table ES-2

Regulatory Options Costs by Subcategory
(in Millions of $1997)

Subcategory	Segment	Regulatory Option	Capital Costs	O&M Costs	One-Time Non-Equipment Costs	Post-Tax Annualized Costs	Pre-Tax Annualized Costs
Cokemaking		BAT 1	$24.18	$4.18	$0.27	$6.09	$6.49
		PSES 1	$6.14	$1.46	$0.09	$1.82	$1.93
Sintering	Sinter	BAT 1	$11.05	$1.30	$0.00	$1.75	$2.57
Other	DRI	BAT 1	$0.00	$0.00	$0.05	$0.005	$0.005
	Forging	BAT 1	$0.12	$0.02	$0.03	$0.03	$0.03

Table ES-3

Industry Costs for Promulgated Rule
(in Millions)

	Promulgated Rule	
	$1997	**$2001**
Capital Costs	$41.5	$45.2
Operating and Maintenance Costs	$7.0	$7.6
One-Time Non-Equipment Costs	$0.4	$0.5
Post-Tax Annualized Costs	$9.7	$10.6
Pre-Tax Annualized Costs	$11.0	$12.0

- less than one-tenth of one percent impact on domestic price, domestic consumption, domestic production, imports, and exports.

Because of these findings, EPA projects no significant impacts on small entities, communities, regions, or the nation. The benefits associated with the rule are estimated to range from $1.3 million to $6.7 million (1997 dollars). In 2001 dollars, the estimated benefits range from $1.4 million to $7.3 million.

CHAPTER 1

INTRODUCTION

1.1 SCOPE AND PURPOSE

The U.S. Environmental Protection Agency (EPA) proposes and promulgates water effluent discharge limits (effluent limitations guidelines and standards) for industrial sectors. This Economic Analysis (EA) summarizes the costs and economic impacts of technologies that form the bases for setting limits and standards for the iron and steel industry.[1]

The Federal Water Pollution Control Act (commonly known as the Clean Water Act [CWA, 33 U.S.C. §1251 et seq.]) establishes a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (section 101(a)). EPA is authorized under sections 301, 304, 306, and 307 of the CWA to establish effluent limitations guidelines and standards of performance for industrial dischargers. The standards EPA establishes include:

- Best Practicable Control Technology Currently Available (BPT). Required under section 304(b)(1), these rules apply to existing industrial direct dischargers. BPT limitations are generally based on the average of the best existing performances by plants of various sizes, ages, and unit processes within a point source category or subcategory.

- Best Available Technology Economically Achievable (BAT). Required under section 304(b)(2), these rules control the discharge of toxic and nonconventional pollutants and apply to existing industrial direct dischargers.

- Best Conventional Pollutant Control Technology (BCT). Required under section 304(b)(4), these rules control the discharge of conventional pollutants from existing industrial direct dischargers.[2] BCT limitations must be established in light of a two-part cost-reasonableness test. BCT replaces BAT for control of conventional pollutants.

- Pretreatment Standards for Existing Sources (PSES). Required under section 307(b). Analogous to BAT controls, these rules apply to existing indirect dischargers (whose discharges flow to publicly owned treatment works [POTWs]).

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[1] The industry, however, is free to use whatever technology it chooses in order to meet the limit.

[2] Conventional pollutants consist of biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, pH, and oil and grease.

New Source Performance Standards (NSPS). Required under section 306(b), these rules control the discharge of toxic and nonconventional pollutants and apply to new source industrial direct dischargers.

Pretreatment Standards for New Sources (PSNS). Required under section 307(c). Analogous to NSPS controls, these rules apply to new source indirect dischargers (whose discharges flow to POTWs).

The current iron and steel rule, 40 CFR Part 420, was promulgated in May 1982 (U.S. EPA, 1982), and was amended in May 1984 as part of a Settlement Agreement among EPA, the iron and steel industry, and the Natural Resources Defense Council (U.S. EPA, 1984). In promulgating Part 420 in 1982, aside from the temporary central treatment exclusion for 21 specified steel facilities at 40 CFR 420.01(b), EPA provided no exclusions for facilities on the basis of age, size, complexity, or geographic location as a result of the remand issues. EPA also revised the subcategorization from that specified in the 1974 and 1976 regulations to more accurately reflect major types of production operations and to attempt to simplify implementation of the regulation by permit writers and the industry. The factors EPA considered in establishing the 1982 subcategories were: manufacturing processes and equipment; raw materials; final products; wastewater characteristics; wastewater treatment methods; size and age of facilities; geographic location; process water usage and discharge rates; and costs and economic impacts. Of these, EPA found that the type of manufacturing process was the most significant factor and employed this factor as the basis for dividing the industry into the twelve process subcategories presented in the 1982 regulation.

1.2 DATA SOURCES

The economic analysis rests heavily on the site- and company-specific data collected under authority of the CWA Section 308 (U.S. EPA, 1998). Other data sources used in the economic analysis include:

Census data.

Trade data and information from the International Trade Commission and the U.S. International Trade Administration (Commerce Department).

Industry data, such as the American Iron and Steel Institute statistics.

Industry journals.

General economic and financial references (these are cited throughout the report).

1.3 REPORT ORGANIZATION

This EA Report is organized as follows:

Chapter 2—Industry Profile
Provides background information on the facilities, companies, and the industry from publicly available sources.

Chapter 3—Survey Data
Summarizes information collected in the EPA survey. The data cover the period 1995 though 1997 and reflect the sites to which the final rule is applicable.

Chapter 4—Economic Impact Methodology
Presents the economic methodology by which EPA examines incremental pollution control costs and their associated impacts on the industry.

Chapter 5—Regulatory Options: Descriptions, Costs, and Conventional Pollutant Removals

Presents short descriptions of and cost estimates for the regulatory options considered by EPA. More detail is given in the Technical Development Document (U.S. EPA, 2002).

Chapter 6—Economic Impact Results
Using the methodology presented in Chapter 4, EPA examined projected impacts for all options considered on a subcategory basis. The chapter presents the projected impacts from the final regulation on site, company, and industry basis.

Chapter 7—Small Business Analysis
EPA is certifying that the final rule will not have a significant economic impact on a substantial number of small businesses. However, EPA did prepare a small business analysis.

Chapter 8—Benefits Analysis
Summarizes the methodology and findings by which EPA identifies, qualifies, quantifies, and—where possible—monetizes the benefits associated with reduced pollution.

- # Chapter 9—Benefit Comparison and Unfunded Mandates Reform Act Analysis
Compares the benefits and costs of the final regulation and shows how the analysis meets the requirements of the Unfunded Mandates Reform Act.

1.4 REFERENCES

U.S. EPA. 2002. Development Document for the Final Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category. EPA-821-R-02-004. Washington, DC: U.S. Environmental Protection Agency, Office of Water.

U.S. EPA. 1998. Collection of 1997 iron and steel industry data: Part A: Technical data. Part B: Financial and economic data. Washington, DC OMB 2040-0193. Expires August 2001.

U.S. EPA. 1984. Part II: Environmental Protection Agency; Iron and Steel Manufacturing Point Source Category Effluent Limitations and Standards. *Federal Register 49:21036*ff. May 17.

U.S. EPA. 1982. Part II: Environmental Protection Agency; Iron and Steel Manufacturing Point Source Category Effluent Limitations and Standards. *Federal Register 47:23258*ff. May 27.

CHAPTER 2

INDUSTRY PROFILE

The industry profile provides background information for those unfamiliar with the iron and steel industry. As such, it sets the baseline against which to evaluate the economic impacts of increased pollution controls. The rulemaking effort covers sites with manufacturing operations in Standard Industrial Classification (SIC) codes:[1]

- 3312: Steel works, blast furnaces (including coke ovens), and rolling mills
- 3315: Steel wiredrawing and steel nails and spikes
- 3316: Cold-rolled steel sheet, strip, and bars,
- 3317: Steel pipes and tubes
- 3479: Electroplating, plating, polishing, anodizing, and coloring; Coat/engrave/allied services not elsewhere classified.

Today, steel spans rivers, forms the bodies of our automobiles and appliances, serves as structural skeletons for buildings, protects food, and supplies a host of different objects in everyday life. But iron and steel have a technological history of over 5,000 years. Based on beads found at Jirzah, Egypt, meteoric iron was worked as early as 3,500 B.C. Smelted iron, dated 2,700 B.C., in the form of a dagger was found at Tall el-Asmar, Mesopotamia (ancient Iraq). Iron served as a flux for copper in earlier objects. Historical texts indicate that archaeological finds are not common because metals were regularly recycled (Moorey, 1988). Different regions (Europe, the Mediterranean, Asia, and Africa) developed ironmaking of different types but with relatively similar technologies. Furnaces were holes in the ground where the draft was introduced through a pipe and bellows. Shaft furnaces, however, relied on natural drafts. Both furnace types involved creating a bed of red-hot charcoal to which a mixture of iron ore and charcoal was added. Chemical reduction of the ore occurred and a “bloom” of iron was produced. The iron was heated and hammered into shape (wrought iron). Wrought iron was more common except in China where cast

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[1]The United States is changing from the SIC system to the North American Industrial Classification System (NAICS). Appendix B cross-references these two systems for the iron and industry.

iron implements dominated (Taylor and Shell, 1988). Carburization may have occurred by allowing the artifact to remain in the forge long enough to render the edges steel (Stech and Maddin, 1988). Steel was known in the Classical Greek and later periods.

Iron-making technology changed very little until medieval times. The blast furnace appeared in Europe in the 15th century when it was realized that cast iron could make one-piece guns with good pressure-retaining properties. Increased iron production led to a scarcity of wood for charcoal. Abraham Darby in 1709 is credited with the realization that coal in the form of coke could be substituted for charcoal. Because of coke's greater strength, it could support larger amounts of ore for processing. The fundamental technology for converting iron ore into iron has been essentially unchanged for the last two centuries. However, the performance of the technology has been remarkably improved. The principal reasons are the mechanization of materials handling and charging, the improvement of furnace design and the increase of furnace size, the improvement of tapping and removal of hot metal, and the recovery and recycle of waste products. Since World War II, dramatic increases in productivity have been achieved using high top pressure, burden beneficiation, wind beneficiation, and supplemental fuel injection. Burden beneficiation techniques have included the firing of iron ore fines, coal dust and lime in a grate-kiln to form uniform pellets, the firing of iron ore fines and other recovered iron units with coke breeze and a flux to form sinter, and the screening of coke to yield uniform size. Wind beneficiation techniques have included the injection of steam and oxygen enrichment of the blast. The last new blast furnace constructed in the U.S. was blown-in (started production) in 1980.

Unlike ironmaking, steelmaking technology has been marked by continual change. The introduction of the pneumatic Bessemer process, which first allowed mass production of steel occurred simultaneously in the 1850s in the United States by William Kelly and Britain by Henry Bessemer. The acid Bessemer process and the related basic Bessemer (or Thomas) process, introduced some years later, replaced two very low productivity production processes (the crucible process and the cementation process). The Siemens regenerative open hearth process was developed in the 1860s and introduced in the U.S. as early as 1868. An open hearth furnace with a basic bottom, rather than the previous acid bottom, went into commercial production in 1888 in Homestead, Pennsylvania. The open hearth process superseded the Bessemer process as the predominant means of steel production in the U.S. in 1908, due to the flexibility of the process and the improved quality of the steel. The electric arc steelmaking furnace was placed in operation in France in 1899 and introduced to the U.S. in 1906.

Until the early 1950s, the open hearth furnace remained the unchallenged premier steel production unit in the U.S. and the world, with the electric arc furnace playing a role in the production of alloy and special steels. The Bessemer converter slowly declined in importance, being surpassed in output by the electric arc furnace in 1948, and with the last new converter shop being built in 1949 (in Lorain, OH) and the last converter being shutdown in 1969 (in Ambridge, PA). In 1952, and 1953, the pneumatic basic oxygen process (BOP) started commercial production in Linz and Donawitz, Austria. The basic oxygen process was introduced in the U.S. in 1954 by McLouth Steel in Detroit. The last new open hearth shop was constructed in 1958. The output of the basic oxygen process surpassed the output of the open hearth process in the U.S. in 1970, after surpassing the electric arc furnace output in 1964. The basic oxygen process provided substantially shorter production times, lower capital and operating costs, and at least equivalent quality. Meanwhile, the electric arc furnace had experienced substantial technological improvements in the 1960s and early 1970s leading to increased output of both carbon and specialty steels, while the open hearth process sharply declined, despite marked technical improvements. The output of electric arc furnaces exceeded the output of open hearth furnaces in 1975 and the final open hearth furnace shop closed in 1991. The basic oxygen process remains the largest producer of steel in the U.S. today with approximately 60 percent of output, even though the number of BOF shops has declined since 1980 and the last new BOF shop was completed in 1991 (the shop actually incorporated used furnaces from another shuttered mill). The electric arc furnace accounts for the remainder of steel production, with a growing output share and new furnaces being added regularly.

Pollution concerns about coke-making are leading to new approaches, one of which involves no coke in the iron-making process. Section 2.1 provides a brief overview of current industry practices; the Development Document accompanying the final rule contains more detailed information (U.S. EPA, 2002).

Given the long history of the manufacture and use of iron and steel, the industry profile presents only a snapshot of the domestic industry against which to evaluate the potential impacts of increased pollution control costs. The industry profile includes:

- Overview of industry processes (Section 2.1)
- Site classification (Section 2.2)
- Products (Section 2.3)
- Subcategories (Section 2.4)
- Environmental protection issues (Section 2.5)
- Production (Section 2.6)
- Specialization and coverage ratios (Section 2.7)
- Major markets (Section 2.8)
- Patterns for the industry 1986-2000 (Section 2.9)
- International competitiveness of the industry (Section 2.10)

2.1 OVERVIEW OF INDUSTRY PROCESSES

A more detailed description of industry processes and technologies may be found in the Development Document accompanying this EA (U.S. EPA, 2002) and AISE, 1985. The text in this section draws heavily on AISE, 1985, and EPA's Preliminary Study and Sector Notebook for the iron and steel industry (U.S. EPA, 1995a and b). Figure 2-1 is a schematic of iron and steelmaking operations from the iron ore to the casting of blooms, billets, and slabs.[2]

2.1.1 Cokemaking

Coke is made by heating pulverized coal in the absence of oxygen. A coke oven is a tall and narrow oven with a charging port on the top side and doors on each of the narrow sides. A coke battery is

[2]Blooms and billets both may be square in cross-section or be less than twice as wide as thick. Blooms are usually more than 36 square inches in cross-section; billets are usually less than 36 square inches. A slab has a width as least twice its thickness.

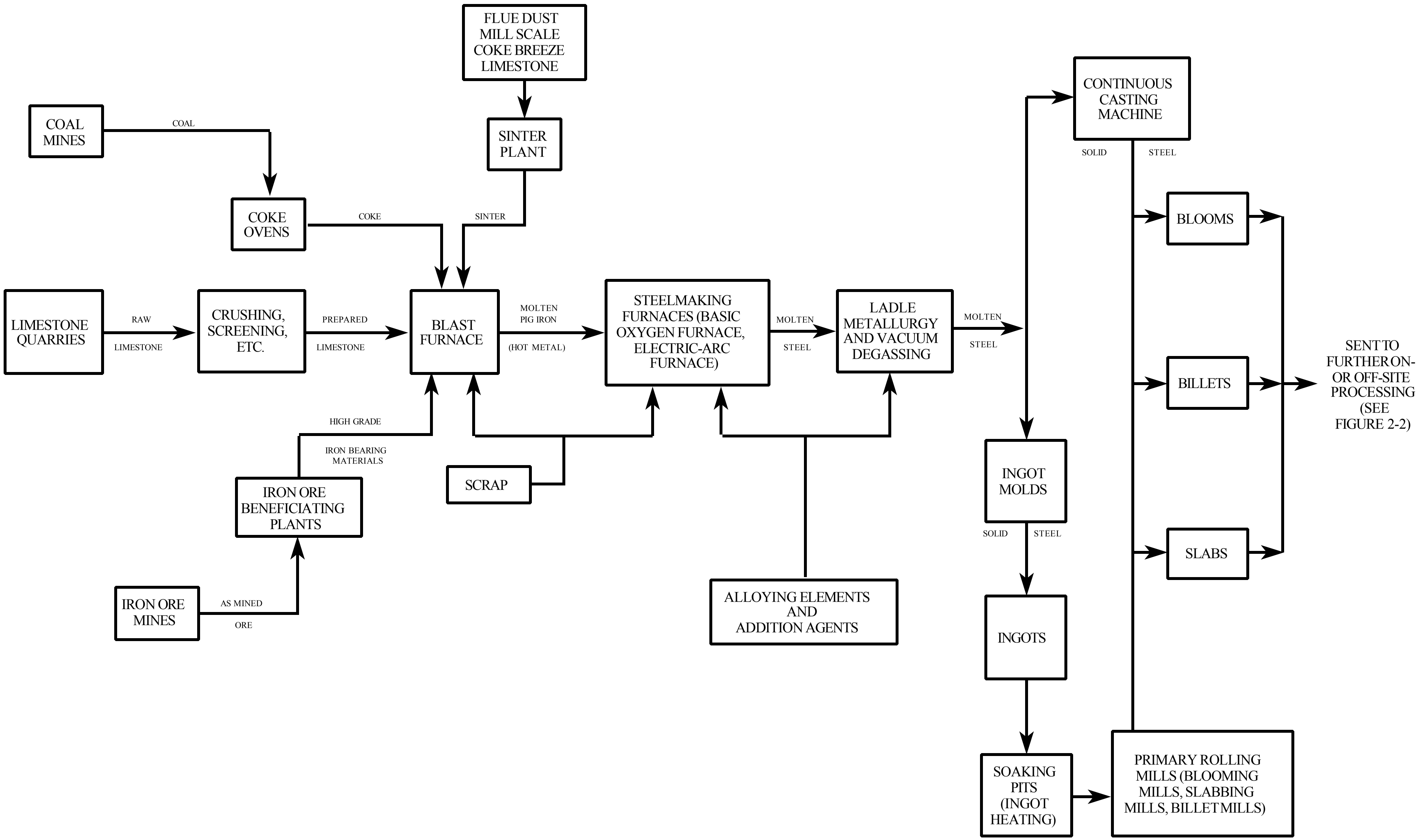


Figure 2-1: Iron and Steelmaking Operations

a series of 10 to 100 individual ovens arranged side by side with a heating flue between each oven pair. The cokemaking process begins with charging the oven with pulverized coal through ports at the top of the oven. After charging, the ports and doors are sealed and the coal is heated in the absence of oxygen Hogan and Koelble, 1996). The heat drives off the volatile components, leaving a relatively pure carbon-rich fuel that burns with high temperature and a relatively small amount of emissions. When the heating cycle is complete, the doors are opened and the coke is pushed from the oven into a rail quench car. The quench car takes the coke to a tower where the coke is cooled with a water spray. Finally, the coke is screened. Coke pieces too small to use in the blast furnace generated during quenching, handling, and screening are called coke fines or coke breeze and are generally used in other manufacturing processes (see Section 2.1.2).

Cokemaking operations can be subdivided several ways:

- what is made (furnace coke or foundry coke, see Section 2.1.1.1)
- who makes it (integrated or merchant producer, see Section 2.1.1.2)
- how it is made (by-product recovery, non-by-product recovery, or direct injection (see Section 2.1.1.3)

2.1.1.1 Types of Coke

The two main types of coke produced in the U.S. are furnace coke and foundry coke. Furnace coke is traditionally used in blast furnaces as part of the steelmaking process. It provides heat , carbon, a reducing agent (carbon monoxide), and structural support within the blast furnace for the reduction of iron ore to iron. Furnace coke accounts for approximately 93 percent of U.S. coke production and is mainly produced in captive operations at integrated steel mills. Some steelmakers may also purchase furnace coke from independent producers as well.

Foundry coke is the other important subgroup of metallurgical coke accounting for approximately 5 to 7 percent of annual U.S. coke production. Foundry coke is primarily used in cupolas as a heat and carbon source for melting scrap, iron and other additives to produce gray iron or ductile iron. The molten iron is then used in the production of castings. Metal castings are used extensively in automotive parts, pipe fittings, and various types of machinery.

The differences between the two types of coke include coke size, coking time, and temperature. Furnace coke is typically made by baking a 10 to 30 percent low-volatile coal mix for 16 to 18 hours at 2200 °F. The coke size produced by this method is about 0.75 to 3 inches. Foundry coke is produced by heating the coking coal to 1800°F for 27 to 30 hours. The heating process for the production of foundry coke is lower than for furnace coke, the length of cooking time is longer, and the resultant foundry coke is also relatively larger than furnace coke, 4 inches or larger in diameter (FR, 2001c). Foundry coke must also have good strength and low ash content (ITC, 2000a).

The EPA survey (see Chapter 3) collected information on 21 by-product recovery coke sites. Fifteen sites produce blast furnace coke for steelmaking, three sites that produce only foundry coke, and three sites that produce both furnace and foundry coke.

2.1.1.2 Types of Producers

Integrated steel producers manufacture coke for consumption within their own iron- and steelmaking operations.[3] In contrast, "merchant coke facility" is one that exists to process coke solely for the purpose of selling the product to customers on the open market. Customers of merchant facilities include integrated steel producers that buy the furnace coke for use in their plants and iron foundries that consume foundry coke.

The 21 by-product recovery coke sites mentioned in the previous section are owned by 18 companies. While foundry coke is made only by merchant producers, furnace coke is made by both integrated and merchant producers. In general, cokemaking operations run by merchant producers tend to be on a smaller scale than those operated by integrated producers (Kaplan and Poppiti, 2001). Three merchant coke producers are classified as small businesses based on the Small Business Administration

[3]Integrated producers will sell excess coke to other steelmakers but only after their own consumptive requirements are met.

(SBA) size definitions for NAICS codes, while none of the integrated producers are classified as small (U.S. EPA, 2000). However, size does not correlate with financial health which lenders certainly examine when evaluating whether to extend credit. Although merchant facilities are smaller than integrated companies, this distinction has no bearing on the ability of a site to raise capital for investment.

Reacting to a slowdown in the demand for steel in the seventies and eighties, several integrated producers shut down coke making operations and this decreased the production of furnace coke in the nineties. Combined with the aging of coke batteries and the expense of rebuilding batteries, integrated producers increased the purchase of furnace coke from merchant producers and ceased producing coke at their captive operations. Such trends in the coke industry have led to an increase in the share of furnace coke production by merchant facilities and an increase in the volume of imports as well (U.S. EPA, 2000).

2.1.1.3 Cokemaking Processes

By-Product Recovery Cokemaking

Moisture and volatile components of the coal are about 20 to 35 percent by weight. In by-product recovery cokemaking, these components are collected and processed to recover coal tars, crude light oil, anhydrous ammonia or ammonium sulfate, naphthalene, and sodium phenolate. Coke oven gas is used as a fuel for the coke oven. Until 1998, nearly all U.S. coke was produced with by-product recovery. Air emissions and water effluents from by-product cokemaking processes are of environmental concern, see Section 2.5. With the promulgation of National Emission Standards for Hazardous Air Pollutants (NESHAP), coke oven batteries are subject to increasingly stringent standards. In response, some aging batteries have shut down, while plants using non-by-product recovery cokemaking methods have opened (see Section 2.1.1.2). Furthermore, other non-coke methods of making iron are being developed (see Section 2.1.3.2).

Non-By-Product Recovery Cokemaking

In non-by-product recovery cokemaking, all volatile gases are incinerated; sulfur is the only remaining pollutant. As such, it is considered a more environmentally-friendly process. The first non-by-product coke plant was Jewell Coal & Coke, which opened in the late 1970s. Not until mid-1998, in light of rising environmental costs, was a second facility built. In 1998, the Sun Coal and Coke Company (Jewell's parent company) opened a newly-built non-recovery coke manufacturing plant at Inland Steel's complex in East Chicago, Indiana. In 1993, Inland ISPAT Steel shut and dismantled its by-product coke ovens largely because of the Clean Air Act regulations. Inland ISPAT Steel has a long term obligation to purchase 1.2 million tons of coke per year. The plant has a capacity of about 1.3 million tons per year. The new coke plant is combined with a waste heat recovery and cogeneration facility (i.e., the excess coke oven gas will generate electricity from steam; Hogan and Koelble, 1996; New Steel 1997; and ENR, 1998).

2.1.2 Sintering

Sintering is a process that recovers iron and agglomerates fine-sized particles ("fines") from iron ores, coke breeze, mill scale, processed slag, wastewater treatment sludges, and pollution control dust into a porous mass for charging to the blast furnace. The materials are mixed together, placed on a slow-moving grate (also called a sinter strand), and ignited. Windboxes under the grate draw air through the materials to enhance combustion. In the process, the fine materials are fused into the clinkers (sinter agglomerates) which can be charged to the blast furnace (U.S. EPA, 1995a and b).

2.1.3 Ironmaking

2.1.3.1 Blast Furnace

Coke, iron ore, limestone and sinter are fed into the top of the blast furnace. Heated air (the blast) is blown into the bottom of the furnace through a pipe and openings (tuyeres) around the circumference of the furnace. The iron-bearing material is supported by the coke and reduced to molten iron and slag as it descends through the furnace. The carbon monoxide from the burning coke reduces the iron ore to iron while the acid part of the ore reacts with the limestone to form slag. The slag floats on top of the molten iron. Slag and iron are tapped periodically through different sets of runners. The term "pig iron" originated in the 15th Century. The iron was tapped down a long channel to which short, straight molds joined at right angles. The layout reminded the ironworkers of a sow suckling piglets, hence the name. Today the 2,800 to 3,000° F iron is tapped into refractory-lined cars for transport to the steel making furnaces while the slag may be used as railroad ballast, as cement aggregate, or for other construction uses (Britannica, 1998; U.S. EPA, 1995a and 1995b).

2.1.3.2 Direct Injection of Pulverized Coal and/or Natural Gas

The injection of pulverized coal and/or natural gas at the tuyeres (openings into the bottom of the blast furnace) reduces coke consumption. Some sites inject oil, tar, or other fuels. Some high-quality coke is still needed in the blast to provide a permeable, high mechanical strength support for hot-metal production. Injection techniques have reduced coke consumption from about 1,000 pounds/ton of hot metal (thm) in 1990 to about 800 pounds/thm in 1995 (Agarwal, et al., 1996). U.S. Steel and National Steel have sites that co-inject both coal and natural gas. Not only is coke usage reduced, but natural gas injection—when combined with proper oxygen enrichment—can boost hot-metal output (Woker, 1998).

2.1.3.3 Alternative Processes

Industry has been developing iron-making alternatives to the blast furnace partly in response to the emissions associated with cokemaking and partly to respond to high scrap steel prices. A steel scrap substitute is a high-iron material in which the iron has been extracted from the ore with natural gas or steam coal as the reductant, i.e., without the use of coke (WSD, 1996a). Table 2-1 is a summary of alternative processes, taken from WSD, 1997a. The most common iron substitutes are directly reduced iron (DRI, where the iron is reduced at temperatures below the melting point of the iron produced), hot-briquetted iron (HBI), and iron carbide (Barnett, 1998). With the industry downturn in 1998-1999, the

Table 2-1

Scrap Steel Substitutes
Summary of Characteristics of Direct Reduction Processes

Process	**Feedstock**	**Reductant**	**Reducer**	**Temperature**	**Pressure**
AREX	Pellet/lump	Gas	Shaft	Medium	Low
Circofer	Fines	Carbon	Fluid bed	High	Medium
Circored	Fines	Gas	Fluid bed	Low	Medium
Davy DRC	Pellet/lump	Carbon	Kiln	High	Atmosphere
FASTMET	Fines	Carbon	Hearth	Very high	Atmosphere
FINMET	Fines	Gas	Fluid bed	Medium	High
HYL III	Pellet/lump	Gas	Shaft	Medium	Medium
Iron Carbide	Fines	Gas	Fluid bed	Low	Medium
Inmetco	Fines	Carbon	Hearth	Very high	Atmosphere
MIDREX	Pellet/lump	Gas	Shaft	Medium	Low
SL/RN	Pellet/lump	Carbon	Kiln	High	Atmosphere

Source: WSD, 1997a

prices for alternative iron dropped, making the viability of some of the projects questionable (Woker, 1999).

Alternative iron sources have been used in the United States for more than a quarter century. GS Industries, Georgetown, SC has used DRI since the 1970s. GS Industries teamed with Birmingham Steel to build a new DRI plant in Convent, LA (American Iron Reduction) that started in the beginning of 1998. Nucor Corporation began operations at an iron-carbide plant in Trinidad in 1994 but shut the plant five years later because of technical difficulties and low pig iron prices (New Steel, 1999a). Corus' DRI shop in Mobile, AL began operations in December 1997 and barges DRI to the Tuscaloosa steelmaking plant. Iron Dynamics, Inc. (IDI)—a subsidiary of Steel Dynamics, Inc. (SDI)—opened a DRI facility in November 1998 that transports the liquid metal across the street to SDI. IDI's start-up has been plagued with breakouts through the refractory wall and the technical difficulties are limiting the metal shipped to SDI in 1999 (Bagsarian, 1998; Woker, 1999; WSD 1996b). Qualitech opened an iron carbide facility in Texas in 1997 and declared bankruptcy less than a year later. A joint venture of LTV and Cleveland Cliffs Inc. in Trinidad uses Lurgi's Circored process to produce HBI.

Although DRI projects are becoming more frequent, DRI needs more careful handling, transport, and storage than HBI or iron carbide. Exposure to moisture may lead to violent reoxidation; in 1996, Russian DRI caught fire during shipping to the U.S. when it improperly came into contact with moisture (WSD, 1997a).

2.1.4 Steelmaking

All steel in the United States is made either in basic oxygen furnaces (BOFs) or electric arc furnaces (EAFs). Both are batch processes with tap-to-tap (batch cycle) times ranging from 45 minutes to 3 hours. The last open hearth furnaces in the United States stopped operating in 1991.

2.1.4.1 Basic Oxygen Furnace

Molten iron from the blast furnace, flux, alloy materials, and scrap are placed in the basic oxygen furnace, melted, and refined by injecting high-purity oxygen. The charge to the BOF is typically about two-thirds molten iron and one-third scrap. Oxygen is injected either through the top of the furnace (top blown), bottom of the furnace (bottom blown), or both (combination blown). Slag is produced from impurities removed by the combination of fluxes with the injected oxygen. Various alloys may be added to produce different grades of steel. Residual sulfur is controlled by managing furnace slag properties. BOF slag can be processed to recover high metallic portions for use in sintering or blast furnaces, but its applications as saleable construction material are more limited than blast furnace slag.

2.1.4.2 Electric Arc Furnace

Scrap steel is the charge to an electric arc furnace. It is melted and refined using electric energy. During melting, oxidation of phosphorus, silicon, manganese, and other materials occurs and a slag forms on the top of the molten metal. Oxygen is used to de-carburize the molten steel and to provide thermal energy.

Because of the absence of cokemaking and blast furnace operations coupled with the ability to be economically scaled for smaller batches, these sites were termed “minimills.” The first use of the term “minimill” seems to be in a 1969 Wall Street Journal article on wiremakers (Depres, 1998). Traditionally, the term “integrated mill” referred to sites with all processes from cokemaking through finishing. Because of recent closures in coke oven batteries, there are integrated mills both with and without cokemaking. The term “minimill” is relative only to a fully integrated mill; minimill EAFs may melt up to 200 to 300 tons per heat. At one point, it might have been common to contrast integrated and minimills in a straight forward manner, e.g., integrated mills had iron-making operations (blast furnaces and BOFs), minimills did not. BOFs are typically used for high tonnage production of carbon steels while EAFs are used to produce carbon steels and low tonnage alloy and specialty steels. When EAF technology first came into operation, it produced typical “long” products where quality was less important than for other products such as reinforcing bars (rebar), beams, and other structural materials.

The distinction is blurring, however. Beginning in 1989, Nucor opened its first EAF-based sheet mill in Crawfordsville, Indiana. Minimills therefore began making the higher-quality sheet products. Nucor is now joined by Gallatin Steel, Steel Dynamics, Trico, North Star, and possibly IPSCO (WSD, 1997b). With Trico, a joint venture of LTV, British Steel, and Sumitomo Metals, traditionally integrated producers began EAF operations. These assets, however, are scheduled to be sold to Nucor, a traditional EAF operator (Nucor, 2001c). With the start up of Iron Dynamics and iron carbide operations in Trinidad, Steel Dynamics and Nucor are "integrating" by controlling these sources of steel scrap substitutes. Iron Dynamics, Inc. is located adjacent to a Steel Dynamics site, indicating the integrated nature of the relationship.

2.1.5 Ladle Metallurgy/Vacuum Degassing

Molten steel is tapped from the BOF or EAF into ladles large enough to hold an entire heat. At this stage, the metal is subjected to temperature control, composition control, deoxidation (O_2 removal), degassing (H_2 removal), decarburizaton to remove other impurities from the steel.

2.1.6 Casting

2.1.6.1 Ingots

After the ladle metallurgy stage, the molten iron is poured (teemed) into ingot molds. The cooled and solidified steel is stripped from the mold, transported to forming operations, reheated, and roughly shaped. Although this was the traditional method of steelmaking, it is being replaced by continuous casting (see below) due to the latter's economic efficiencies.

2.1.6.2 Continuous Casting

Continuous casting methods bypass several of the conventional forming steps by casting steel directly into semifinished shapes. Molten steel is poured into a reservoir (tundish) from which it is released to a water-cooled mold at controlled rates. The steel solidifies as it descends through the casting machine mold, emerging from the mold with a hardened shell. The steel feeds onto a runout table where the center solidifies sufficiently to allow the cast to be cut into lengths. Blooms, billets, round, and slab-shaped pieces may be continuously cast.

2.1.7 Hot Forming

With hot-forming operations, the flow diagram changes from Figure 2-1 to Figure 2-2. The semi-finished steel shapes are re-heated to about 1,800° F and passed between two rolls revolving in opposite directions where the mechanical pressure reduces the steel's thickness. While a single rolling stand feeds the steel through in one direction, the hot rolling mill may be a reversing mill that adjusts the space between the rolls and feeds the steel back in the opposite direction. Or, a site may have a series of rolling stands where each stand in the series progressively reduces the thickness of the steel. A 40-foot slab entering a hot rolling mill may exit as a 5,000 foot strip. The final shape, thickness, and characteristics of the steel depends on the rolling temperature, rolling profile, and the cooling processes after rolling.

2.1.8 Acid Pickling/Salt Descaling

In this step, steel is immersed to remove oxide scale from the surface of the semi-finished product prior to further processing. The process may be batch or continuous. In the latter cases, coils may be welded end-to-end at the start of the line and cut by torch at the end of the line. Sulfuric acid, hydrochloric acid, or a combination of the two are common pickling solutions. In salt descaling, the aggressive physical and chemical properties of molten salts are used to remove heavy scale from selected specialty and high-alloy steels. Two proprietary baths are available, one oxidizing (Kolene) and one reducing (Hydride).

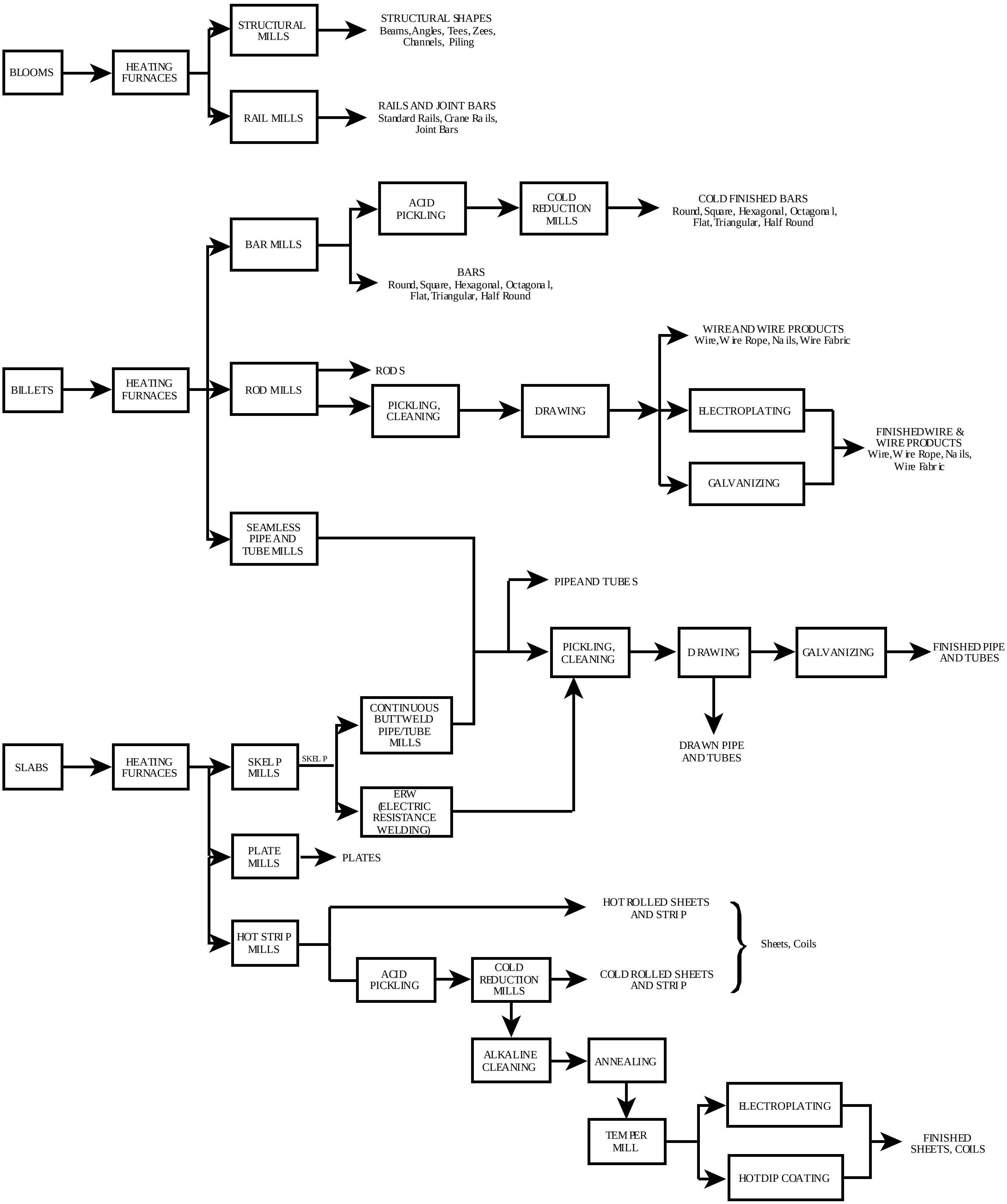


Figure 2-2: Forming and Finishing Operations

2.1.9 Cold Forming

Cold forming involves the rolling of hot rolled and pickled steel at ambient temperature. The reduction in thickness is small compared to that in hot rolling. Cold rolling is used to obtain improved mechanical properties, better machinability, special size accuracy, and thinner gages than can be economically produced with hot rolling. Cold rolling is generally used to produce wire, tubes, sheet, and strip steel products. During cold rolling, steel becomes hard and brittle. The steel is heated in an annealing furnace to make it more ductile.

2.1.10 Finishing

One of the most important aspects of a finished product is the surface quality. Several finishing processes are in current use: alkaline cleaning, hot dip coating, galvanizing, and electroplating. Qualities desired in the final product will determine which process or combination of processes is used.

2.1.10.1 Alkaline Cleaning

Alkaline cleaning typically occurs after cold forming and prior to hot coating or electroplating. The purpose is to remove mineral oils and animal fats and oils from the steel surface, i.e., preparing a surface that will accept a later coating. Alkaline cleaning involves baths that are less aggressive than pickling operations.

2.1.10.2 Hot Dip Coating

Hot dip coating operations involve immersing cleaned steel into molten baths of:

- Tin
- Zinc (galvanizing)

- Zinc and aluminum (galvalume coating)

- Lead and tin (terne)

Sometimes coating operations have a final step such as chromium passivation. Hot coating is usually performed to improve corrosion resistance and/or appearance (U.S. EPA 1995a and 1995b).

2.1.10.3 Electroplating

Electroplating involves covering the steel product with a thin layer of metal through chemical changes induced by passing an electric current through an ionic solution. The food and beverage market uses tin and chromium electroplated projects. Zinc electroplated (electro-galvanized) steel is used in the automotive market. The latter market has been increasing in recent years due to automobile manufacturers demand. New coatings, such as combinations of iron, nickel, and other metals, are under development and refined in response to market specifications.

2.2 SITE CLASSIFICATION (INTEGRATED/NON-INTEGRATED/STAND-ALONE)

Not all sites have all the operations described in Section 2.1. For the purpose of designing the CWA section 308 survey, EPA uses three terms to generally classify iron- and steelmaking sites:

- Integrated. Traditionally, integrated steel mills performed all basic steelmaking operations from cokemaking through finishing. Today, the term refers to a site that has a blast furnace or BOF, many of the integrated sites having closed their cokemaking and sintering operations.

- Non-integrated. Also known as “minimills,” these sites have EAFs and do not have blast furnaces or BOFs.

- Stand-alone. A stand-alone site has no melting capability. Stand-alone facilities cover a wide range in operations. There are stand-alone coke plants ranging in capacity from 615 tons/day (Tonawanda Coke) to 12,280 tons/day (U.S. Steel Clairton Works; Hogan and Koelble, 1996). Stand-alone sites with finishing operations typically process hot rolled steel into finished steel products by pickling, cold-rolling, cleaning, hot coating, or electroplating. Other stand-alone facilities manufacture tube and pipe or wire from semi-finished steel.

The general categories may be broken down further by facilities that manufacture or finish carbon, alloy, and/or stainless steels (see Section 2.3). Stand-alone facilities may be located near or adjacent to other steelmaking operations but typically have separate wastewater treatment systems and discharge permits.

2.3 PRODUCTS

The three principal steel types produced in the United States are carbon, alloy, and stainless (U.S. EPA, 1998). They are defined as:

- Carbon. Carbon steel owes its properties chiefly to various percentages of carbon without substantial amounts of other alloying elements. Steel is classified as carbon steel if it meets the following conditions: (1) no minimum content of elements other than carbon is specified or required to obtain a desired alloying effect, and (2) the maximum content for any of the following do not exceed the percentages noted: manganese (1.65%), silicon (0.60%), or copper (0.60%).

- Alloy. Steel is classified as alloy when the maximum range for the content of alloying elements exceeds one or more of the following: manganese (1.65%), silicon (0.60%), or copper (0.60%), or in which a definite range or definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: aluminum, boron, chromium (less than 10%), cobalt, lead, molybdenum, nickel, niobium (columbium), titanium, tungsten, vanadium, zirconium, or any other alloying element added to obtain a desired alloying effect.[1]

- Stainless. Stainless steel is a trade name given to alloy steel that is corrosion and heat resistant. The chief alloying elements are chromium, nickel, and silicon in various combinations with possible small percentages of titanium, vanadium, and other elements. By American Iron and Steel Institute (AISI) definition, a steel is called “stainless” when it contains 10% or more chromium.

[1]Specialty steel is a steel containing alloying elements added to enhance the properties of the steel when individual alloying elements (e.g. aluminum, chromium, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium) are more than 3%, or the total of all alloying elements exceeds 5 percent.

Carbon steels have diverse uses and are produced in much greater quantities than alloy and stainless steels. Alloy steels are used where enhanced strength, formability, hardness, weldability, corrosion resistance, or notch toughness is needed for specific applications. Stainless steels are designed for corrosion-resistant applications or where surface staining is not desired.

2.4 SUBCATEGORIZATION

EPA proposed re-subcategorizing in December 2000 but, due to the small number of subcategories affected by the final rule, the Agency has decided to retain the 1982 subcategory structure with the addition of an "other operations" subcategory. To assist the reader in comparing the Economic Assessments for proposal and promulgation, Table 2-2 summarizes the changes in subcategorization, see also U.S. EPA, 2002.

2.5 ENVIRONMENTAL PROTECTION ISSUES

EPA promulgated NESHAP for coke oven emissions (doors, lids and offtakes charging and leaks) in 1993. Cokemaking sites are faced with three choices:

- Meet the Maximum Achievable Control Technology (MACT) limits in 1995 and more stringent limits in 2003. The 2003 limits are either MACT limits more stringent than the 1995 values or residual risk standards (RRS) that limit the risk to public health in the surrounding communities, depending upon whichever is more stringent (known as the "MACT track").

- Meet a series of three increasingly stringent emissions limits consistent with the Lowest Achievable Emissions Rate (LAER). The first deadline was November 1993, the second deadline was January 1998, and the third deadline is January 2010. Full compliance with RRS must occur in 2020. (known as the "Extension track").

- Cokemakers may choose to "straddle" the tracks until 1998. If this option is chosen, the site must meet the interim standards under both the MACT and Extension tracks until 1998. At that time, a cokemaker could decide to forgo RRS compliance for a battery. If so, the battery may operate until 2020 before it must meet residual risk standards (known as the "Straddle track").

Table 2-2

Iron and Steel Manufacturing Subcategories

<table>
<tr><th>1982</th><th colspan="2">Proposed 2000</th><th>Final 2002</th></tr>
<tr><td>A. Cokemaking</td><td colspan="2">A. Cokemaking</td><td>A. Cokemaking</td></tr>
<tr><td>B. Sintering</td><td colspan="2" rowspan="2">B. Ironmaking</td><td>B. Sintering</td></tr>
<tr><td>C. Ironmaking</td><td>C. Ironmaking</td></tr>
<tr><td>D. Steelmaking</td><td rowspan="3">C. Integrated Steelmaking</td><td rowspan="4">D. Non-Integrated Steelmaking and Hot Forming</td><td>D. Steelmaking</td></tr>
<tr><td>E. Vacuum Degassing</td><td>E. Vacuum Degassing</td></tr>
<tr><td>F. Continuous Casting</td><td>F. Continuous Casting</td></tr>
<tr><td>G. Hot Forming</td><td>E. Integrated and Stand-Alone Hot Forming</td><td>G. Hot Forming</td></tr>
<tr><td>H. Salt Bath Descaling</td><td colspan="2" rowspan="5">F. Steel Finishing</td><td>H. Salt Bath Descaling</td></tr>
<tr><td>I. Acid Pickling</td><td>I. Acid Pickling</td></tr>
<tr><td>J. Cold Forming</td><td>J. Cold Forming</td></tr>
<tr><td>K. Alkaline Cleaning</td><td>K. Alkaline Cleaning</td></tr>
<tr><td>L. Hot Coating</td><td>L. Hot Coating</td></tr>
<tr><td></td><td colspan="2">G. Other Operations</td><td>M. Other Operations</td></tr>
</table>

If a coke battery could not meet the January 1998 LAER limits, it must either close or rebuild (Hogan and Koelble, 1996). This deadline occurs just as the survey period ends, so the cokemaking profile may need to be adjusted to address these changes. The second deadline for the MACT sites is 2003. EPA proposed MACT standards for coke pushing and quenching on July 3, 2001 and for integrated iron and steel on July 13, 2001 (FR 2001c and 2001d).

2.6 PRODUCTION

There are potential difficulties with both the Current Industrial Reports (Census) data and American Iron and Steel Institute (AISI) data for the EPA analysis. First, the sites in the Census and AISI data span two EPA effluent guideline subcategories—iron and steel and metal products and machinery. Because the regulated community examined in this analysis is a subset of that presented in secondary data, EPA relies on the survey data when evaluating impacts. Second, EPA surveyed the iron and steel industry in the Fall of 1998, requesting data for fiscal years 1995, 1996 and 1997. During this period, the government was changing from the Standard Industrial Classification (SIC) to the North American Industry Classification System (NAICS). The 1997 Current Industrial Report (MA33B(97)) presents data by product code related to SIC codes (DOC, 1998). The 1997 Census, however, presents data by NAICS code. The Small Business Administration noted that it intends to convert business size standards to NAICS effective 1 October 2000 (FR, 1999). This industry profile, then, reports some information via SIC code (see beginning of Chapter 2) and some by NAICS code (see Section 2.7) depending on the form in which the data are available.[2] For the two reasons listed above, production data for the regulated community is based on EPA survey data, presented in Chapter 3.

2.7 SPECIALIZATION AND COVERAGE RATIOS

A specialization ratio represents a comparison between primary products shipped and total products shipped by establishments classified within the industry. A coverage ratio represents the ratio of primary products shipped by establishments classified in the industry to total shipments of such products by all manufacturing establishments, wherever classified (DOC, 1999a).

The ratios retrieved from the Census for the purpose of our analysis include the following product categories: NAICS 331111 iron and steel mills, NAICS 331210 steel pipes and tubes, NAICS 331221 cold finishing of steel shapes, and NAICS 331222 steel wire and related products. Table 2-3 displays the specialization and coverage ratios for the above product categories from the 1997 Census data. Each

[2]Appendix B cross-references the NAICS and SIC codes for the iron and steel industry.

Table 2-3

Specialization and Coverage Ratios

NAICS	Description	Specialization Ratio	Coverage Ratio
331111	Iron and Steel Mills	97%	98%
331210	Pipes and Tubes Manufactured from Purchased Steel	96%	93%
331221	Cold Rolled Steel Shape Manufacturing	83%	90%
331222	Steel Wire Drawing	96%	91%

Sources: DOC, 1999b through 1999d.

product category, with the exception of cold finishing of steel shapes, has a specialization ratio of 96 percent or higher. The high specialization ratios indicate that the establishments within the industry have total production that consists mostly of their primary products. The coverage ratios range from 90 percent to 98 percent. These coverage ratios indicate that the total production of these particular categories is generated by establishments within the industry and not by other manufacturing establishments outside of the industry.

2.8 MAJOR MARKETS

2.8.1 Service Centers

Service centers and distributors are the largest domestic market for steel shipments. A service center is an "operation that buys finished steel, often processes it in some way and then sells it in a slightly different form" (SSCI, 1999). Service center staff alter the steel (e.g., slit, cut to length, pickled, annealed, etc.) and sell the product at a higher value. Products, processes, and markets may vary by service center. In general, service centers sell the refined product to either fabricators, manufacturers, or the construction industry. In 2000, steel mills shipped about 30.1 million tons of steel to service centers and distributors, accounting for about 28% of the market (AISI, 2000). The more than 5,000 service centers are located mainly in the northeastern United States with a smaller concentration in the southeast. Service centers are less capital-intensive than steel mills and compete with steel mills for providing finished products to the end market.

2.8.2 Construction

Construction is the second largest market for steel industry with 2000 steel shipments amounting to about 20.3 million tons (19% of the market). Between 1991 and 2000, shipments for construction increased by 8.8 million tons (AISI, 2000). This results from an increase in commercial and residential building with steel. From 1992 to 1994, the number of homes built with steel increased from 500 to 75,000 (Cyert and Fruehan, 1996). Steel offers advantages in strength and stability during adverse weather conditions (e.g., rot resistance without chemicals) and natural disasters. With "aggressive marketing, changes to building codes, and instruction to home builders," the steel industry has a goal of reaching one-quarter of the market by 2000 (Cyert and Fruehan, 1996).

2.8.3 Automotive

Motor vehicles are the third largest market for steel in the United States. In 2000, the automotive industry had more than 16 million tons of steel shipments (about 15% of the market). The sales increase of the heavier sport utility vehicles helped fuel an overall increase in steel shipments of 6 million metric tons from 1991 to 2000 (AISI, 2000). Recently, however, other materials compete for an increasing share of motor vehicles. Plastic and aluminum have become more popular with the demand for lower-weight and more gas-efficient automobiles. Steel is heavier than these materials, but it is more durable, safer, and easier to recycle. Steel producers and the automobile industry are working together to improve the steel efficiency in today's cars. The leading world steel producers have joined together to form the UltraLite Steel Autobody-Advanced Vehicle Concepts (ULSAB-AVC) program (Ulsab, 2000). This is an auto design and engineering program intended to exhibit that steel can reduce weight, increase safety, and lower cost. Using these ideas, Porsche vehicle weight has decreased 25% with the continued use of steel. The use of more advanced steels such as corrosion-resistant and stainless steel increased in the 90's as well.

2.8.4 Remaining Markets

Service centers, automotive, and construction markets account for about 61 percent of steel shipments. The remaining 39 percent is dispersed over a wide range of products and activities, such as agricultural, industrial, and electrical machinery, cans and barrels, and appliances. The building of other transportation means such as ships, aircraft, and railways are included in this group as well.

2.9 PATTERNS FOR THE INDUSTRY 1986-2000

2.9.1 Raw Steel Production

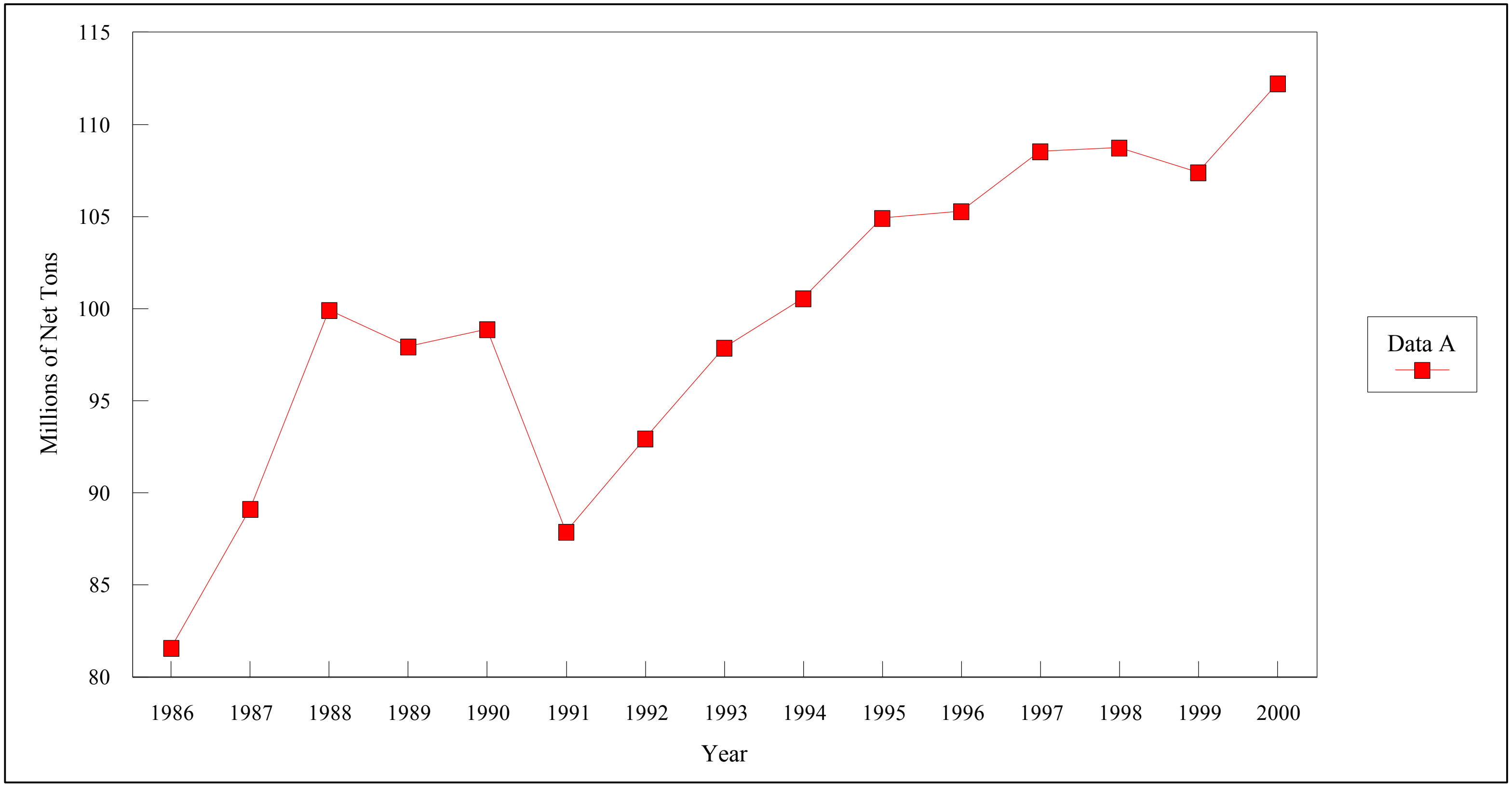
Figure 2-3 traces the domestic production of raw steel from 1986 through 2000. The time series begins in 1986 with 81.6 million tons and climbs to nearly 100 million tons in 1988. After stabilizing for a few years, production drops to 88 million tons in the 1991 recession. From 1991, steel production has increased annually to 112 million tons.

2.9.2 Steelmaking Capacity and Capacity Utilization

Figure 2-4 shows both steelmaking capacity (left axis, black squares) and capacity utilization (right axis, shaded diamonds). Because steelmaking is a capital intensive industry with high fixed costs, capacity utilization is a measure of the industry’s ability to run profitably. There is an ebb and flow in capacity utilization over time as industry tries to balance supply and demand. In 1986, the United States had its highest steelmaking capacity and lowest production in the fifteen-year period, resulting in a dismal capacity utilization rate of 64 percent. The industry reduced its capacity sharply in 1987 by about 15

Figure 2-3

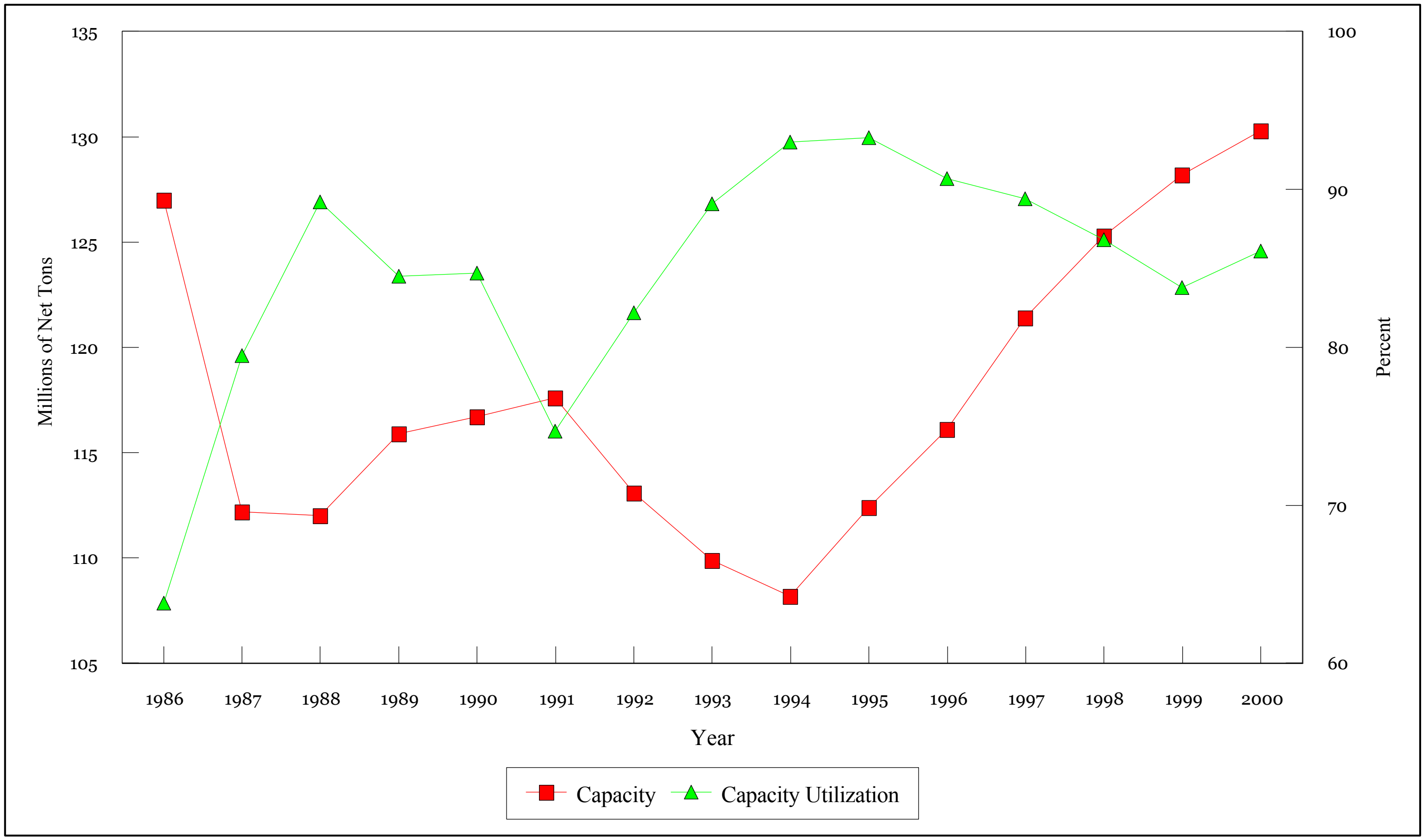
Raw Steel Production in the United States: 1986-2000



Source: AISI, 2000, 1998, 1995

Figure 2-4

Steelmaking Capacity and Capacity Utilization in the United States: 1986-2000



Source: AISI, 2000, 1998, 1995

million tons. This, coupled with an increase in steel production, increased capacity utilization to nearly 80 percent. Further growth in production in 1988 pushed capacity utilization to 89 percent.

With the improving market, individual companies added capacity in 1989. Steel production leveled off and capacity utilization slipped to 85 percent, where it stayed for the next year. (1990 capacity increases were offset by increased production.) 1991 brought small continuing capacity additions but a sharp drop in raw steel production, resulting in a capacity utilization rate of 75 percent.

From 1991 through 2000, domestic steel production increased (see Figure 2-3). Perhaps in response to the conditions in 1991, the industry closed capacity over the next three years. This resulted in a climb in the utilization rate that peaked in 1994 at 93 percent. There was a slight increase in utilization in 1995 (93.3 percent) but the industry began adding capacity again. From 1995 through 2000, the industry added nearly 18 million tons of capacity. The robust economy—with its increasing steel use—absorbed much of this increase, but capacity utilization began a slow, consistent decline, reaching 86 percent in 2000.

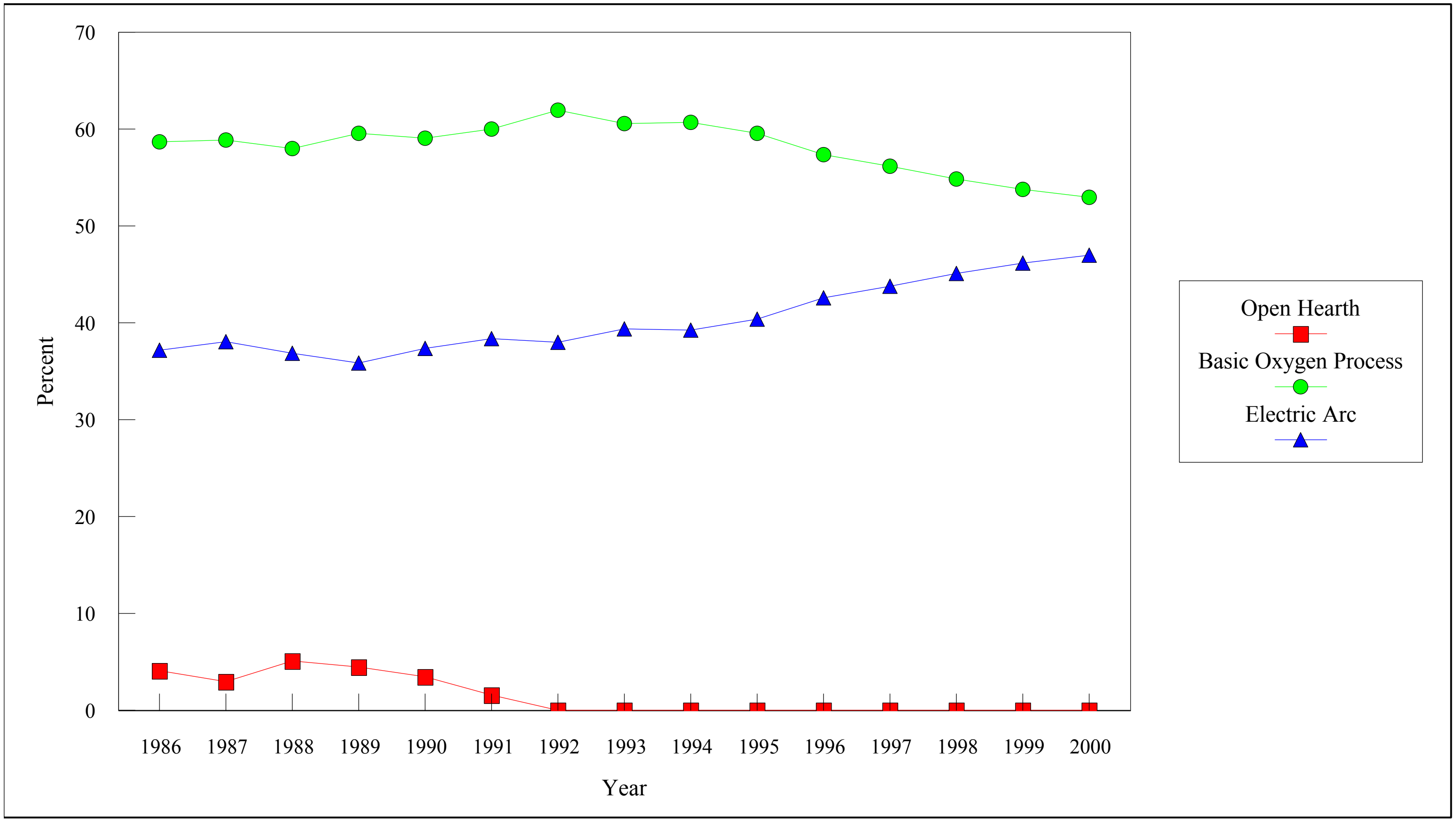
The fluctuations in capacity utilization imply that steel is a cyclical industry, in terms of profits, even when steel consumption shows a monotonic increase (see Figures 2-3 and 2-4, 1991-2000). The fluctuating possibility for profits has implications for the revenue forecasting model used in the site financial analysis (see Chapter 4).

2.9.3 Raw Steel Production by Furnace Type

Figure 2-5 shows the relative production of steel by open hearth, basic oxygen process (BOP), and electric arc furnaces (EAF). Open hearth production ceased in 1991. From 1992 through 2000, the percentage of steel made with BOP furnaces declined while that for EAF production rose. In effect, Figure 2-5 illustrates the growing strength of the minimills versus integrated producers.

Figure 2-5

Percent Raw Steel Production by Furnace Type in the United States: 1986-2000



Source: AISI, 2000, 1998, 1995

2.9.4 Continuous Casting

As described in Section 2.1.6, once the metallurgy of the steel is finalized, the ladle pours the liquid metal either into ingots or to a continuous caster. Ingots may be used on-site or sold as a commodity. In the first case, the ingot must be "soaked" in a temperature-controlled pit to equalize the temperature throughout the cross-section. (When cast, the exterior of the ingot cools faster than the interior.) In the second case, the ingot must be heated until it reaches a temperature at which it can be rolled into a semifinished shape (e.g., slabs, billets, or blooms). In continuous casting, the metal is cast directly to a semifinished shape, thus condensing three steps into one (ingot casting, heating, and rolling) with concomitant energy and time savings. Continuous casting began in the United States in the 1960s (AISE, 1985). By 1986, more than half of the steel produced in the United States was continuously cast. The percentage continued to climb over the years, with slightly more than 96 percent of the steel being continuously cast in 2000 (see Figure 2-6). The importance of continuous casting as a technological impact on the steel industry is reflected in the market model, see Chapter 4.

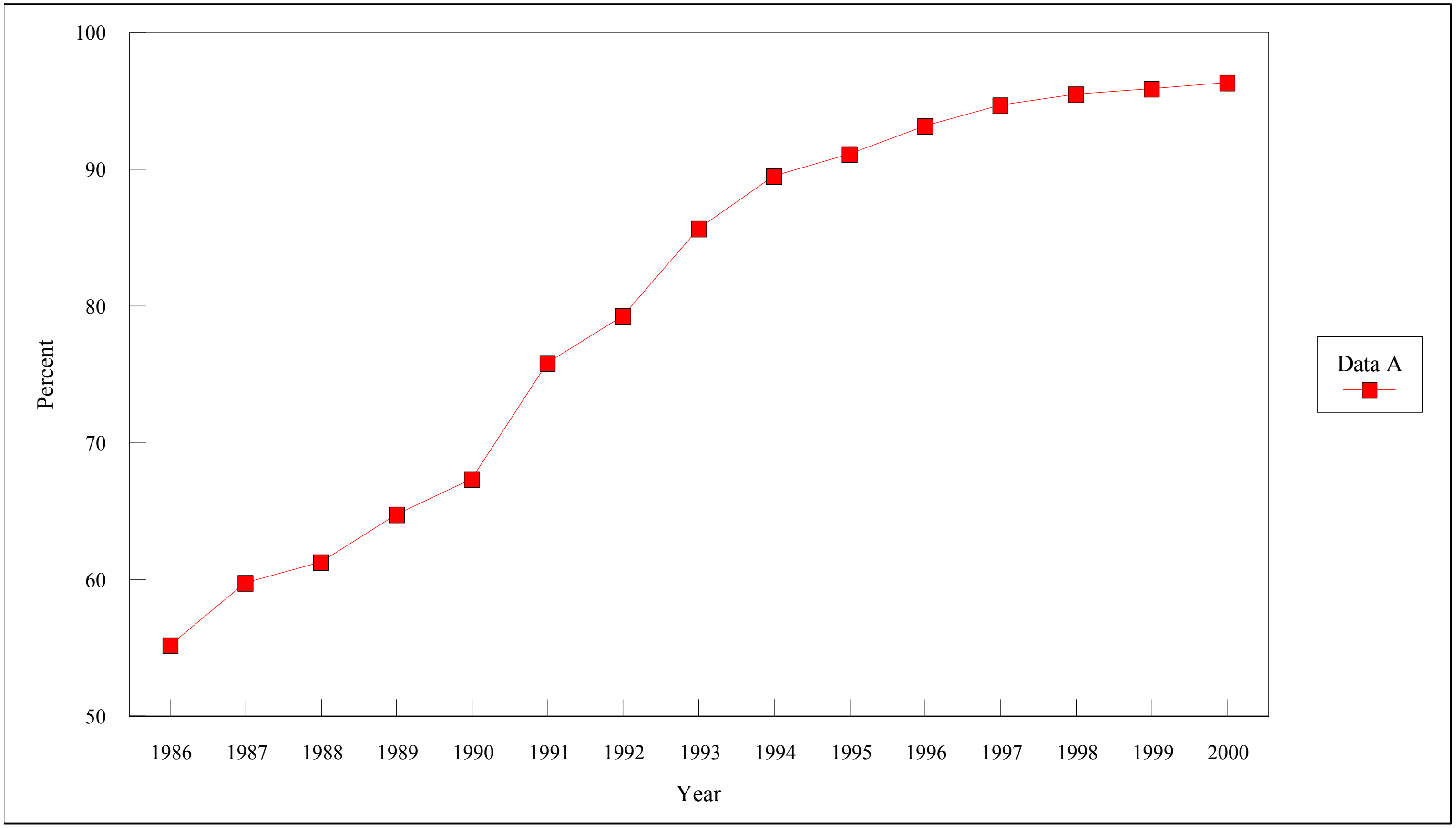
2.9.5 Imports/Exports

The United States is one of the three largest raw steel producers in the world, accounting for 11 to 12 percent of total world production during 1986 to 2000. (Japan and the People's Republic of China are the other two countries; OECD, 1999, AISI, 2000, and AISI, 1999.) This is a notable drop from the market share held by the U.S. industry in the early 1970s. The period from 1973 to 1982 saw U.S. market share drop in half from nearly 20 percent to 10 percent. The turmoil in the industry during this period explains the industry's sensitivity to imports and its willingness to fight what it considers unfair practices through international trade cases (see Section 2.10 for a more detailed discussion of recent trade cases). Figure 2-7 illustrates the percentage of imports in the United States steel industry. From 1986 to 2000 the percentage of imports has varied from a low of 15 percent in 1993 to a high of just more than 26 percent in 1998.

Import and export tonnage for 1986-2000 is illustrated in Figure 2-8. The U.S. has been a consistent net importer during this period. Import tonnage ranged from 20 to 26 million net tons from 1986

Figure 2-6

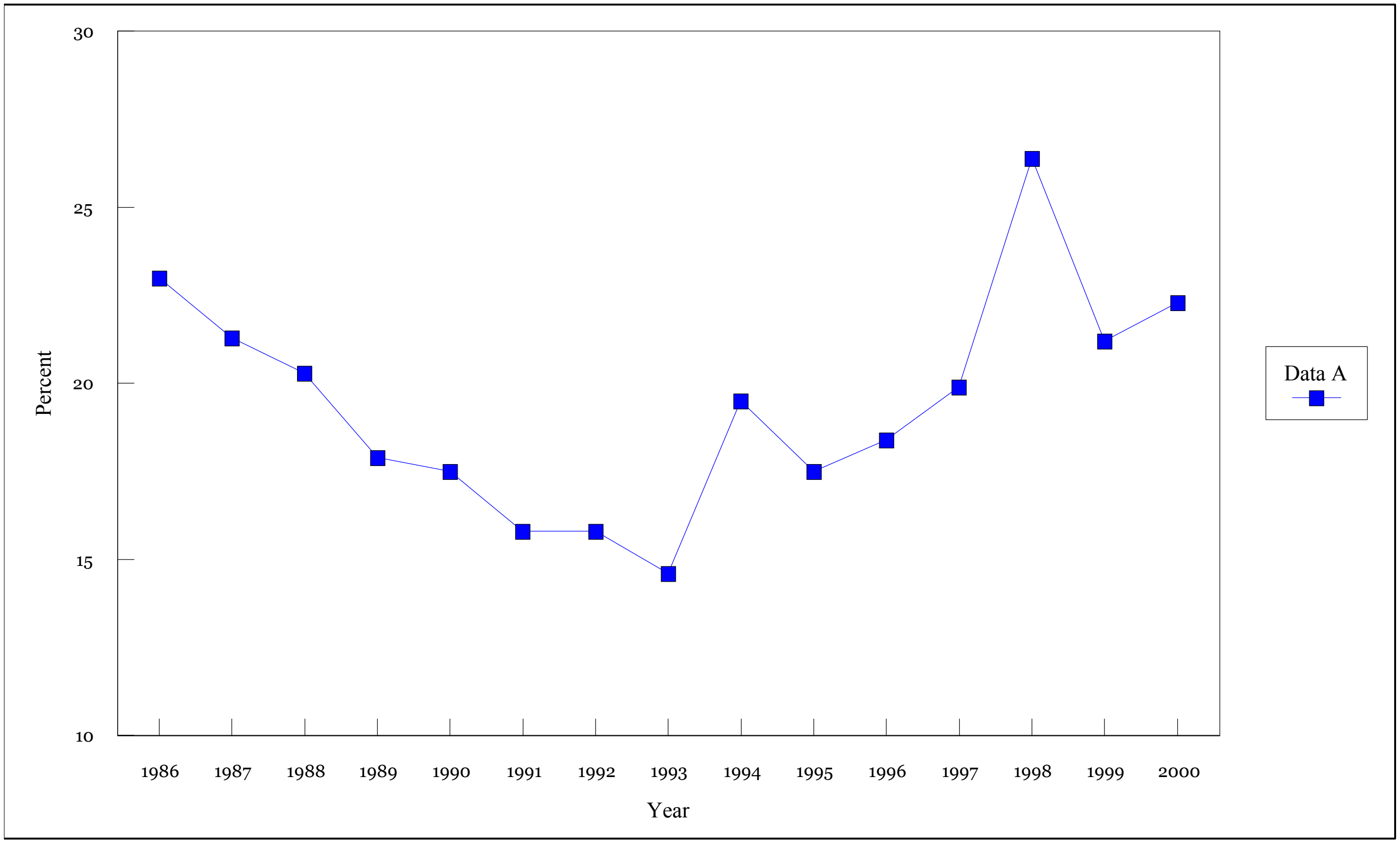
Percent Continuously Cast Steel in the United States: 1986-2000



Source: AISI, 2000, 1998, 1995

Figure 2-7

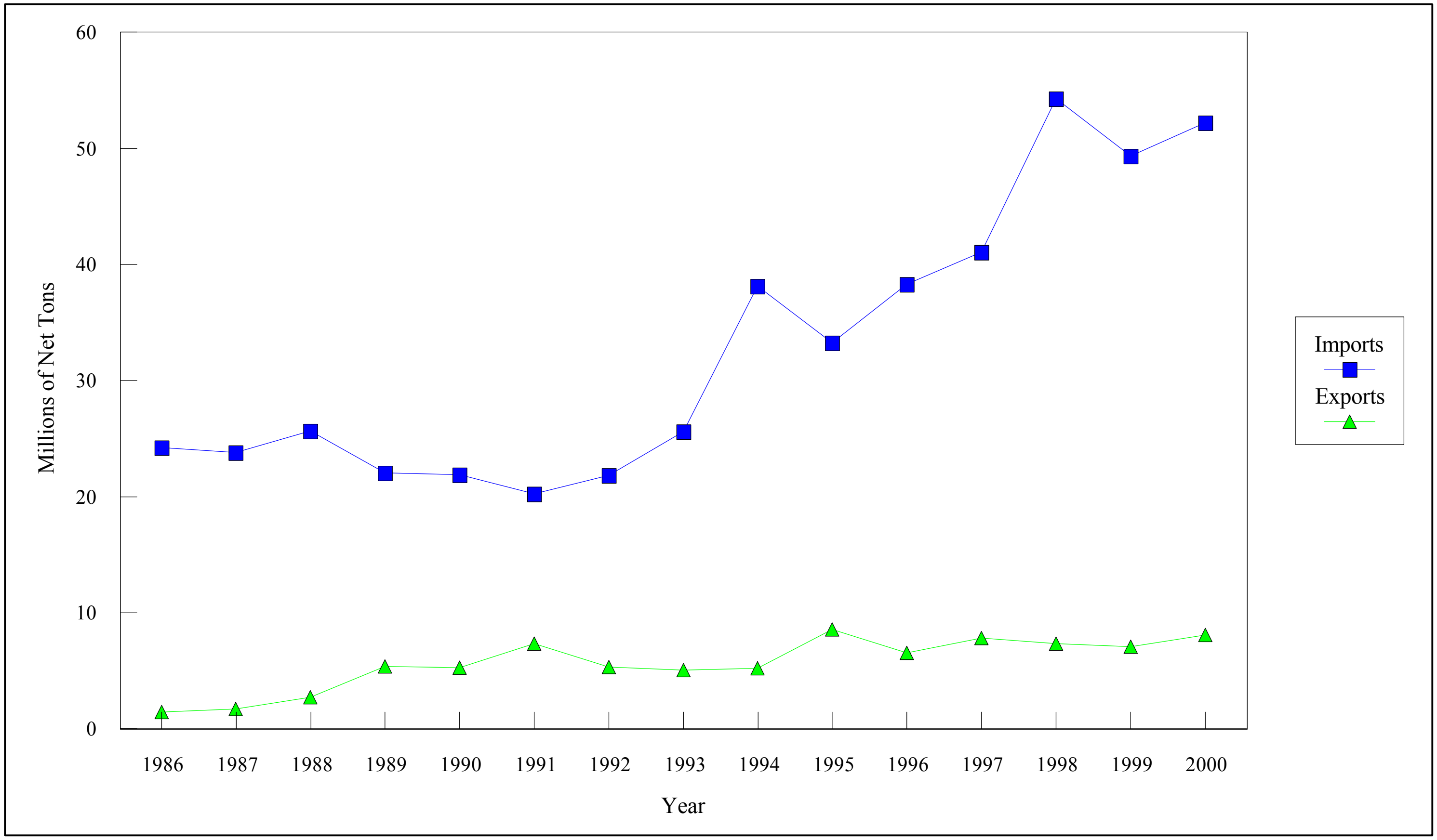
Percent Imports of Steel Industry in the United States: 1986-2000



Note: Data for 1998 excludes semi-finished imports.
Source: AISI, 2000, 1998, 1995

Figure 2-8

Iron and Steel Import/Export Tonnage in the United States: 1986-2000



Source: AISI, 2000, 1998, 1995

through 1993. Although U.S. raw steel production increased by about twelve percent from 100.6 million tons in 1994 to 112.2 million tons in 2000 (Figure 2-3), domestic production could not keep pace with increased demand. Imports jumped to 38 million tons in 1994 and jumped again to 54 million tons in 1998, a 43 percent increase. In 1999, imports declined slightly to 49 million tons, increasing again in 2000 to 52 million tons.

2.9.6 Employment

Employment peaked about 1974 when the industry had slightly over half a million jobs (both wage and salaried). As mentioned in the previous section, the industry contracted severely during the late 1970s and early 1980s. In 1986, total employment was approximately 175,000 with 128,000 employees receiving wages (Figure 2-9). By 2000, total employment dropped to fewer than 100,000 and wage-based employment dropped to 74,000 employees.

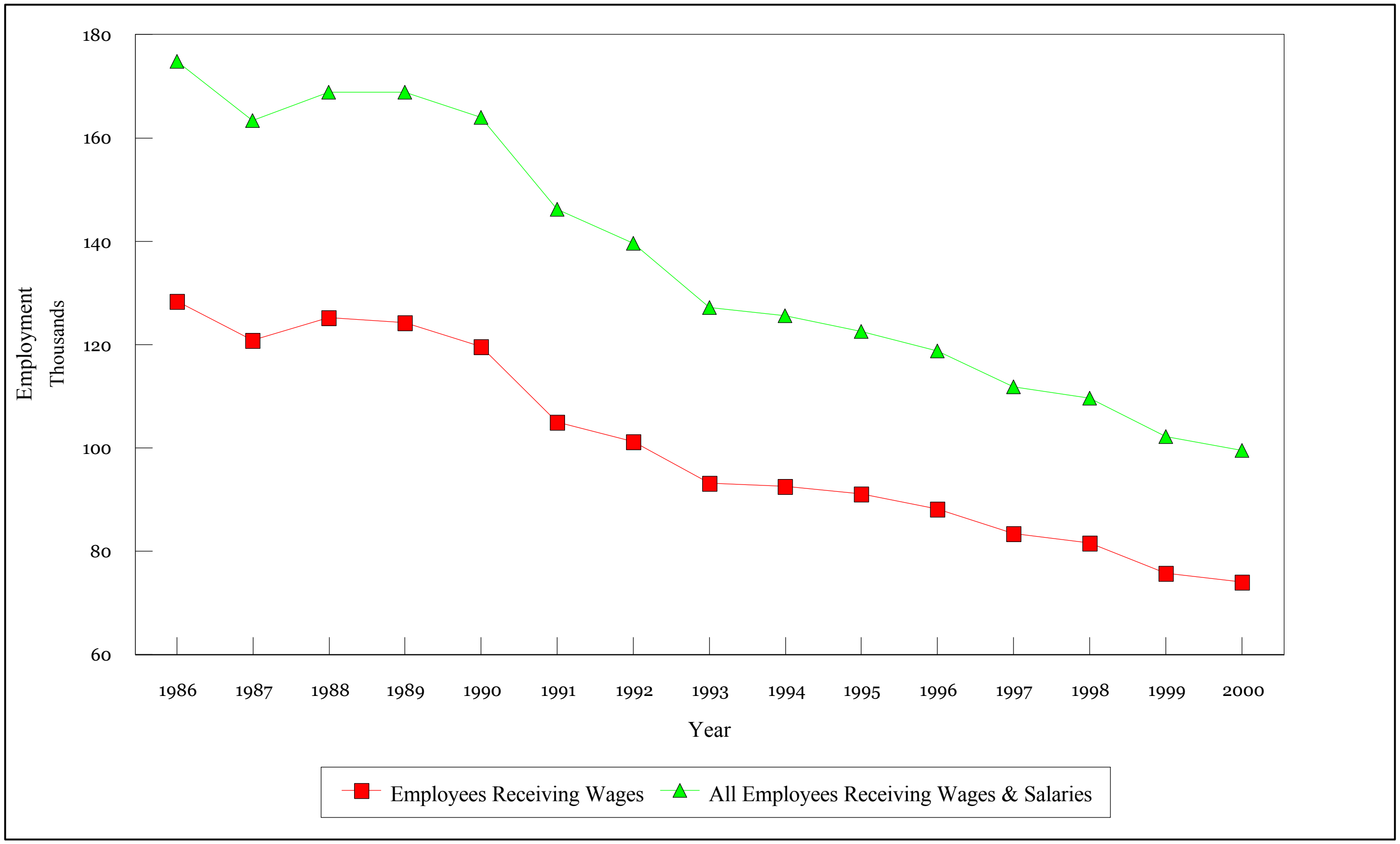
A reduced number of jobs does not coincide completely with a constriction in the industry. Part of the loss in employment reflects technological advances, such as continuous casting, that allow steel to be made faster and with fewer people. Raw steel production increased (Figure 2-3) while employment decreased (Figure 2-9). In 1986, it took 174,783 employees to make 81,606 thousand tons of raw steel or about 467 tons per employee per year or 4.5 hours per ton. In 2000, it took 99,536 employees to make 112,242 thousand tons of raw steel or about 1,128 tons per employee per year or 1.9 hours per ton. That is, the labor required to produce a ton of steel in 2000 is slightly more than 40 percent of the labor required fifteen years earlier. Technological change, then, is a driving factor in this industry. (See Chapter 4 for a further discussion of the role of technological change in the market model.)

2.9.7 Industry Downturn: 1998-2000

The EPA survey collected financial data for the 1995-1997 time period (the most recent data available at the time of the survey). This three-year time frame marks a period of high exports (six to eight million tons per year, see Section 2.10.1). This high point in the business cycle allowed companies to

Figure 2-9

Average Number of Employees Engaged in the Production and Sale of Iron and Steel Products in the United States: 1986-2000



Source: AISI, 2000, 1998, 1995

replenish retained earnings, retire debt, and take other steps to reflect this prosperity in their financial statements.

The financial situation changed dramatically between 1997 and 1998 due to the Asian financial crisis and slow economic growth in Eastern Europe.[3] When these countries' currencies fell in value, their steel products fell in price relative to U.S. producers. While the U.S. is and has been the world's largest steel importer (and a net importer for the last two decades), the U.S. was nearly the only viable steel market to which other countries could export during 1998. U.S. imports jumped by 13.3 million tons from 41 million to 54.3 million tons—a 32 percent increase—from 1997 to 1998 (see Section 2.10.1). About one out of every four tons of steel consumed in 1998 was imported. The situation somewhat improved in 1999 as imports feel back to 49 million tons, but increased again in 2000 to 52 million tons. At least partly due to increased competition from foreign steel mills, the financial health of the domestic iron and steel industry also experienced a steep decline after 1997. This decline is not reflected in the survey responses to the questionnaire, which covered the years 1995 through 1997 and which were the most recent data available at the time the questionnaire was administered in 1998.

EPA compiled public information about steel company bankruptcies since 1997. The information is summarized in Table 2-4. Nineteen companies are in bankruptcy, at least three of which have ceased operations (Acme Metals, Qualitech Steel, and Gulf States Steel). Geneva recently idled its hot end operations. Five companies merged with healthier ones. Companies that were financially healthy before the down turn are finding opportunities to expand their market share. For example, Nucor acquired Auburn Steel in March 2001, and agreed to purchase Trico's assets in November 2001 (Nucor, 2001a through 2001c). Other companies filed trade cases with the International Trade Commission and the International Trade Administration of the Commerce Department (see Section 2.10.2).

The Clinton Administration launched an initiative to address the economic concerns of the steel industry in 1999. The Steel Action Plan includes initiatives focused on eliminating unfair trade practices that support excess capacity, enhanced trade monitoring and assessment, and maintenance of strong trade laws (DOC, 2000a).

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[3]Although the industry downturn is discussed here in general terms, details on imports, exports, and trade cases are discussed in more detail in Section 2.10.

Table 2-4

Selected Steel Company Changes Since 1997

Company	Bankruptcy and Other Events	Date
Acme Metals	Bankruptcy Began liquidation of Acme Steel Company	September 1998 October 2001
Laclede Steel	Bankruptcy Emerged from bankruptcy Bankruptcy	November 1998 December 2000 July 2001
Geneva Steel	Bankruptcy Emerged from Bankruptcy Bankruptcy	February 1999 January 2001 January 2002
Qualitech Steel Corp	Bankruptcy (ceased operations)	March 1999
Gulf States Steel	Bankruptcy Liquidation	July 1999 August 2000
J&L Structural	Bankruptcy	June 2000
Wheeling-Pittsburgh Steel	Bankruptcy	November 2000
Northwestern Wire and Steel	Bankruptcy	December 2000
LTV	Bankruptcy	December 2000
American Iron Reduction	Bankruptcy	January 2001
CSC Limited	Bankruptcy	January 2001
GS Industries	Bankruptcy	February 2001
Trico Steel	Bankruptcy Nucor to purchase assets	March 2001 November 2001
Republic Technologies	Bankruptcy	April 2001
Precession Specialty Metals	Bankruptcy	July 2001
Standard Steel/Freedom Forge	Bankruptcy	July 2001
Bethlehem Steel	Bankruptcy	October 2001
Sheffield Steel	Bankruptcy	December 2001
National Steel	Bankruptcy	March 2002

Sources: Acme, 2001; AISE, 2001; Geneva, 2001; Gulf States, 2001; Laclede, 2001; New Steel 2001a, 2001c, and 2001d; Nucor, 2001a; Steel Profiles, 2001; USWA, 2002; and Coyne, 2002.

Further, in a separate action on August 17, 1999, President Clinton signed into law an act providing authority for guarantees of loans to qualified steel companies. The Emergency Steel Loan Guarantee Act of 1999 (Pub L 106-51) established the Emergency Steel Guarantee Loan Program (13 CFR Part 400) for guaranteeing loans made by private sector lending institutions to qualified steel companies. The Program will provide guarantees for up to $1 billion in loans to qualified steel companies. These loans will be made by private sector lenders, with the Federal Government providing a guarantee for up to 85 percent of the amount of the principal of the loan. A qualified steel company is defined in the Act to mean: any company that is incorporated under the laws of any state, is engaged in the production and manufacture of a product defined by the American Iron and Steel Institute as a basic steel mill product, and has experienced layoffs, production losses, or financial losses since January 1998 or that operates substantial assets of a company that meets these qualifications. Certain determinations must be made in order to guarantee a loan, including that credit is not otherwise available to a qualified steel company under reasonable terms or conditions sufficient to meet its financing needs, that the prospective earning power of the qualified company together with the character and value of the security pledged must furnish reasonable assurance of repayment of the loan to be guaranteed, and that the loan must bear interest at a reasonable rate. All loans guaranteed under this Program must be paid in full not later than December 31, 2005 and the aggregate amount of loans guaranteed with respect to a single qualified steel company may not exceed $250 million.

According to a March 1, 2000 press release from U.S. Department of Commerce, thirteen companies have applied for loan guarantees totaling $901 million (DOC, 2000b). Of these, the Emergency Steel Loan Guarantee Board approved loans to seven companies:

- Geneva Steel Company, $110 million (DOC, 2000c).
- GS Technologies Operating Company, $50 million (DOC, 2000c).
- Northwestern Steel and Wire Company, $170 million (DOC, 2000c).
- Wheeling-Pittsburgh Steel Corporation, $35 million (DOC, 2000c).
- Acme Steel, $100 million (DOC, 2000d).
- Weirton Steel Corporation, $25.5 million (DOC, 2000d).
- CSC, Ltd., $60 million (DOC, 2000e.)

Since then, four of the above companies, Northwestern, GS Technologies, CSC Ltd., and Wheeling-Pittsburgh have entered bankruptcy and would need to file a new application for the loans (New Steel, 2001b). Of the seven companies, only one remains out of bankruptcy (see Table 2-4). On October 18, 2000, the Emergency Steel Loan Guarantee Board announced a second window from November 1, 2000 until March 31, 2001 for applications (DOC, 2000f). In light of the resurgence of imports in 2000 from countries other than those named in the trade cases (MetalSite, 2000), the future financial health of some members of the iron and steel industry is far from certain.

2.10 INTERNATIONAL COMPETITIVENESS OF THE INDUSTRY

2.10.1 Exports/Imports

Table 2-5 lists U.S. steel industry's imports and exports from 1986 through 2000. Even though the U.S. exported anywhere from 1.5 million to 8.6 million tons of steel in any given year, its imports far outweighed its exports. In 1998, the year after the data represented in the EPA survey, net imports skyrocketed by nearly one-third from 33 million tons to 47 million tons. Not only did imports surge, the price of the imported steel was so low due to currency fluctuations and the Asian fiscal crisis that U.S. companies could not sell at a profit. Several companies declared bankruptcy (see Table 2-4) and layoffs occurred at other sites. Steel is clearly a global commodity where the U.S. is severely affected by financial conditions half a world away. Table 2-6 provides greater detail on import and export changes between 1997 and 2000 by country or region of origin. All regions except for the EU show a tremendous increase in imports from 1997 to 2000. One recourse for the industry was to file legal action alleging unfair trade practices. These are discussed in Section 2.10.2.

2.10.2 Trade Cases

In response to the flood in imports, the domestic steel producers filed several lawsuits alleging unfair trade practices by foreign producers. These cases have arisen as a consequence of supposed dumping of iron and steel products or alleged unfair subsidization of foreign firms by their governments.

Table 2-5

Imports and Exports of Iron and Steel (in Tons)

Year	Imports	Exports	Trade Deficit
1986	24,237,800	1,451,254	22,786,546
1987	23,836,367	1,707,717	22,128,650
1988	25,659,253	2,757,389	22,901,864
1989	22,056,070	5,374,332	16,681,738
1990	21,882,058	5,308,667	16,573,391
1991	20,237,275	7,376,114	12,861,161
1992	21,872,600	5,340,066	16,532,534
1993	25,644,394	5,048,552	20,595,842
1994	38,135,623	5,210,419	32,925,204
1995	33,243,871	8,568,271	24,675,600
1996	38,327,538	6,576,860	31,750,678
1997	41,048,045	7,826,559	33,221,486
1998	54,303,217	7,335,029	46,968,188
1999	49,346,398	7,090,427	42,255,971
2000	52,201,896	8,108,479	44,093,417

Sources: AISI, 2000, 1998, and 1995.

Table 2-6

Imports by Countries of Origination and Exports by Countries of Destination for Iron and Steel Products (in Tons)

Country/World Region	1997 Imports	1997 Exports	2000 Imports	2000 Exports
Canada	6,041,758	4,550,711	6,694,263	4,936,676
Mexico	3,778,389	1,467,806	4,024,761	1,876,565
Other Western Hemisphere	7,246,876	646,635	10,168,985	328,167
European Union	7,943,483	349,026	7,594,096	397,010
Other Europe	7,371,736	38,162	8,817,258	80,726
Oceania	683,337	34,760	1,040,460	36,252
Africa	971,807	154,646	1,549,595	55,044
Total Asia	7,010,659	584,804	12,312,479	398,041
Total	**41,048,045**	**7,826,550**	**52,201,897**	**8,108,481**

Sources: AISI, 2000 and 1998.

Section 2.10.2.1 provides background material to trade cases, how they are filed, the parties involved, and the sequence of decisions that may or may not lead to penalties on the exporting countries. Section 2.10.2.2 focuses on recent steel trade cases.

2.10.2.1 Background

Dumping occurs when a foreign producer sells a product in the United States at a price that is below that producer’s sales price in the country of origin. Dumping may also occur if the producer sells the product at a price below the cost of production. Price discrimination is a result of dumping because the firm is charging different prices for the same product in different markets. Ultimately, if a foreign producer is dumping, the home market will not experience perfectly competitive conditions. Likewise, if the threat of sanctions results in a country voluntarily reducing exports to the U.S. (before a determination is reached) or if sanctions are levied, the market will not be operating under competitive conditions.

Another action that may lead to unfair market conditions for home producers is subsidization of foreign producers by foreign governments. Foreign governments subsidize industries by providing financial assistance to benefit the production, manufacture, or exportation of goods. Subsidies may take many forms, including cash payments, credits against taxes, and loans at terms that do not reflect the market condition. United States statutes and regulations provide standards to establish if a subsidy is unfair to producers in the U.S.

Industries in the United States may request that antidumping or countervailing duties be issued by filing a petition with both Commerce Department and International Trade Commission (ITC). The Import Administration of the Commerce Department determines if dumping or unfair subsidization has occurred. ITC decides whether the industry producers in the United States are suffering material injury as a result of the dumped or subsidized products. Generally, the final steps of the investigation is completed within twelve to eighteen months of the date the petition was initiated. Both the Import Administration and ITC must confirm findings of dumping or unfair subsidization and injury in order to proceed with the issuance of duties against imports of a product into the United States.

The Department of Commerce's Import Administration calculates dumping margins by comparing the difference between the price of the product in the U.S. to the price of the product in the firm's home market or the cost of production. The Import Administration adjusts the value to account for differences in price resulting from physical characteristics, levels of trade, quantities sold, circumstances of sale, applicable taxes and duties, and packing and delivery costs. The dumping margin is the result of the difference between the two prices. Subsidy rates are determined by the value of the benefit provided by subsidies on a company-specific basis. The amount of subsidies that a foreign producer receives from its government provides a basis by which the subsidy is offset or countervailed through higher import duties.

2.10.2.2 Recent Steel Trade Cases

The industry filed numerous countervailing duty and antidumping cases with the U.S. DOC and the U.S. ITC charging various countries with unfair trade practices concerning carbon and stainless steel products. The countries commonly named in the trade cases are in the Pacific Rim (Japan, S. Korea, and

Taiwan), and Europe (France, Germany, Italy, Czech Republic, and Russia). ITC decisions may determine that imports from some, none, or all of the countries listed in the petition caused injury.

Due to the surging imports of hot-rolled steel and other products, the Department of Commerce shifted resources to its Import Administration to expedite investigations, thus shortening the time required for decisions. The Department of Commerce also determined that it could make an early critical circumstances determination, thereby putting importers on notice that they might be liable retroactively for up to 90 days of duties prior to the preliminary dumping determination. Russia decided to negotiate with the United States to restrict exports of hot-rolled steel and 15 other steel products by 64 percent rather than incur trade remedies. Imports of hot-rolled steel (sheet, strip, and plate) surged to nearly 1.5 million metric tons in November 1998, the same month many of the early critical circumstances determinations were made. December 1998 imports of hot-rolled steel fell 65 percent compared to the previous month (DOC, 2000g and New Steel, 1999b). The combination of trade case decisions and recession had January through October 2001 imports down 25 percent compared to the same period in 2000 (ITA, 2001b).

Table 2-7 summarizes the findings of recent trade cases. The ITC found for the U.S. industry in most, but not all, cases; this means that it determined that the domestic industry was materially injured or threatened with material injury by the imports. The aggressive pricing by the foreign steel exporters resulting in substantial dumping margins, see 185 percent for hot-rolled flat carbon products (Russia), 164 percent for cold-rolled flat carbon products (Slovakia), and 106 to 108 percent for carbon seamless pipe (Japan).

2.10.2.3 Recent Coke Trade Cases

In August 1999, the House Committee on Ways and Means requested ITC to review the foundry coke industries in the U.S. and the People's Republic of China and to provide various market information for 1995-1999. That report appeared in July 2000 (ITC, 2000a). Among other observations, the report notes that China is now the world's largest exporter of foundry coke while it imports none and the U.S. is the largest importer of Chinese foundry coke. In September 2001, the ITC made a final determination that

Table 2-7

Recent Steel Products Trade Cases

Product	Countries	Range of Margins (percent)	AD or CVD Orders	Negative DOC or ITC Decisions
Stainless steel plate in coils	6 AD, 4 CVD	2-45	9	0*
Stainless steel round wire	6 AD	3-36	0	6
Stainless steel sheet and strip in coils	8 AD, 3 CVD	0-59	11	0
Carbon hot-rolled steel flat products	3 AD, 1 CVD	6-185	4	0
Carbon-quality cut-to-length plate	8 AD, 6 CVD	0-72	11	3
Carbon quality cold-rolled flat products	12 AD, 4 CVD	7-164	0	16
Carbon/alloy seamless pipe (over 4.5")	2 AD	11-106	2	0
Carbon alloy seamless pipe (4.5" or less)	4 AD	20-108	4	0
Structural steel beams	4 AD, 1 CVD	26-65	1	2
Tin mill products	1 AD	32-95	1	0
Circular stainless steel hollow products	1 AD	0	0	1
Carbon quality cold-rolled flat products	1AD	47-63	1	0
Stainless steel bar	6 AD, 1 CVD	0-126	P	P
Steel wire rope	2 AD	0	0	2
Stainless steel angle	3 AD	24-115	3	0
Steel rebar	12 AD	17-133	8	4
Hot-rolled steel products	9 AD, 4 CVD	0-91	12	0
Structural steel beams	8 AD	P	P	P

AD = antidumping. CVD - countervailing duty. P = Preliminary determination.
*The ITC split the case into two like products and went affirmative with respect to stainless hot-rolled plate in coils.

Sources: DOC, 2000g; FR, 2000; FR 2001a; FR 2001b; FR 2001e through 2001j; ITA 2001a; ITC, 2000a through 2000c; ITC 2001a though 2001f; and ITC 2001h though 2001i.

the domestic foundry coke industry is materially injured by imports from the People's Republic of China (ITC, 2001j). The anti-dumping margins for specific manufacturers/exporters range from 48 percent to 106 percent. For all other manufacturers/exporters, the margin is 215 percent. The antidumping duties are effective as of 8 March 2001 (FR, 2001l). Since China is the only country that exports foundry coke to the United States (ITC, 2001j), the domestic industry should improve its financial performance as a result of this trade case.

In August 2001, the ITC made a preliminary determination that there was no reasonable indication of injury from imports of blast furnace coke from China and Japan (ITC, 2001g).

2.10.2.4 Section 201 Steel Trade Case

On June 22, 2001, the Office of the United States Trade Representative requested the initiation of an investigation by the ITC of certain steel imports under the Section 201 of the Trade Act of 1974. A later request from the Senate Finance Committee was consolidated under the same investigation. Investigations under this law may be requested when increased imports of a product from all countries are alleged to be a substantial cause of serious injury, or threat of serious injury, to a U.S. industry. The investigation does not require the finding of an unfair trade practice. The investigation is composed of two phases, the injury phase and, if an affirmative injury determination is made, the remedy phase. In the remedy phase, the ITC recommends a remedy to the President, who decides what relief, if any, will be imposed. The remedy may consist of tariffs, quantitative restrictions, orderly marketing agreements, and trade adjustment assistance. In addition, the ITC may recommend that the President initiate international negotiations to address the underlying cause of the increase in imports or that he implement any other action authorized under the law that is likely to facilitate positive adjustment to import competition.

On October 22, 2001, the ITC affirmatively determined that 12 products (or product categories) are being imported into the U.S. in such increased quantities that they are a substantial cause of serious injury or threat of serious injury to the U.S. industry. On an additional four products (or product categories), the ITC was evenly divided, meaning they will continue to be included in the investigation. The imported products covered by the investigation accounted in year 2000 for 27 million tons of steel valued at

$10.7 billion. The products included carbon steel slabs, plate, hot rolled sheet, cold rolled sheet, coated sheet, tin mill products, hot rolled bar and light structural shapes, cold finished bar, rebar, welded tube, stainless bar, stainless rod, tool steel, and stainless wire.

The ITC voted on remedy recommendations on December 7, 2001 and submitted its determinations and recommendation to the President on December 19, 2001. On March 5, 2002, President Bush imposed a three-year set of quotas and tariffs. For flat-rolled, tin-mill, and bar (hot rolled and cold finished), tariffs are 30 percent the first year, 24 percent the second year, and 18 percent the third year. For rebar, pipe (welded tubular), stainless rod, and stainless bar, tariffs are 15 percent the first year, 12 percent the second year, and 9 percent the third year. The tariff for stainless wire is 8 percent for the first year and drops to 6 percent in the third year. A 30 percent tariff is imposed on steel slabs after a 5.4 million-ton quota. (ITC, 2001k; FR 2001k; and FR 2002).

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CHAPTER 3

EPA SURVEY

EPA used the *Collection of 1997 Iron and Steel Industry Data* (hereinafter referred to as the "EPA Survey") to obtain detailed technical and financial information from a sample of iron and steel facilities potentially affected by the rule. EPA used its authority under Section 308 of the Clean Water Act to collect information not available otherwise, such as:

- site-specific data
- financial information for privately-held firms and joint entities.

EPA could not use Census or industry data, such as the American Iron and Steel Institute's annual statistics because both sources contain data for a mix of sites in two EPA categories: (1) iron and steel and (2) metal products and machinery. Hence, the survey is the only source for information crucial to the rulemaking process. EPA sent out two versions of the survey, a "detailed" and a "short (so-called because of their relative lengths and complexity). Section 3.1 summarizes the site-level information while Section 3.2 reviews the company-level information.

3.1 SITE-LEVEL INFORMATION

The EPA Survey collected information on site-level and company-level bases for a sample of the iron and steel industry. The site-level information forms the basis for the economic impact analysis for the site closure and direct impact analysis. The EPA Survey is the only source for this information. The company information forms the basis of the corporate financial distress analysis. The EPA Survey is the only source of information for privately-held firms and joint entities. (See Chapter 4 for more details on the economic impact methodology.)

EPA developed a sampling frame of 822 sites divided into 12 strata. Of these, 402 sites were drawn in the sample to receive a survey. Some strata were censused (i.e., all sites in the stratum were sent a survey) while others were randomly sampled. On investigation of the data, many of the sites were determined to be more appropriately covered by the proposed MP & M rulemaking (See Technical Development Document for more detailed discussion). The national estimates are:

- 254 iron and steel sites
- 127 direct dischargers
- 65 indirect dischargers
- 6 sites with both direct and indirect discharges
- 56 zero dischargers (includes sites that do not discharge process wastewater as well as sites that are completely dry).

The sum of direct, indirect, and zero dischargers does not equal the total number of sites because sites may both directly and indirectly discharge wastewater. (See U.S. EPA, 2000 for more details on the survey.)

3.1.1 Geographic Distribution

Figure 3-1 shows the location of the 25 sites with cokemaking operations. The map is divided into EPA regions. All but one of the sites occur east of the Mississippi River in EPA regions 2 through 5. Due to the cost of transportation, the sites are clustered around the Great Lakes, along river systems or near the coal beds of West Virginia/Western Pennsylvania. The exception is Geneva Steel in Utah in EPA region 8.

The integrated steel sites follow a geographical pattern similar to that for cokemaking sites, see Figure 3-2. The sites occur in EPA Regions 3, 4, 8, and the heaviest concentration in Region 5. The latter is also a major location of the automobile manufacturing industry, one of the steel industry's largest clients.

The non-integrated sites have a much wider distribution across the United States (Figure 3-3). Because the major raw materials are scrap and electricity, the sites are less reliant on water transport. All EPA regions but Region 1 have at least one non-integrated steel manufacturing site. The stand-alone sites—such as cold-forming and pipe and tube operations—are more numerous than the non-integrated sites and are dispersed throughout the United States (not shown).

Figure 3-1
Cokemaking Sites

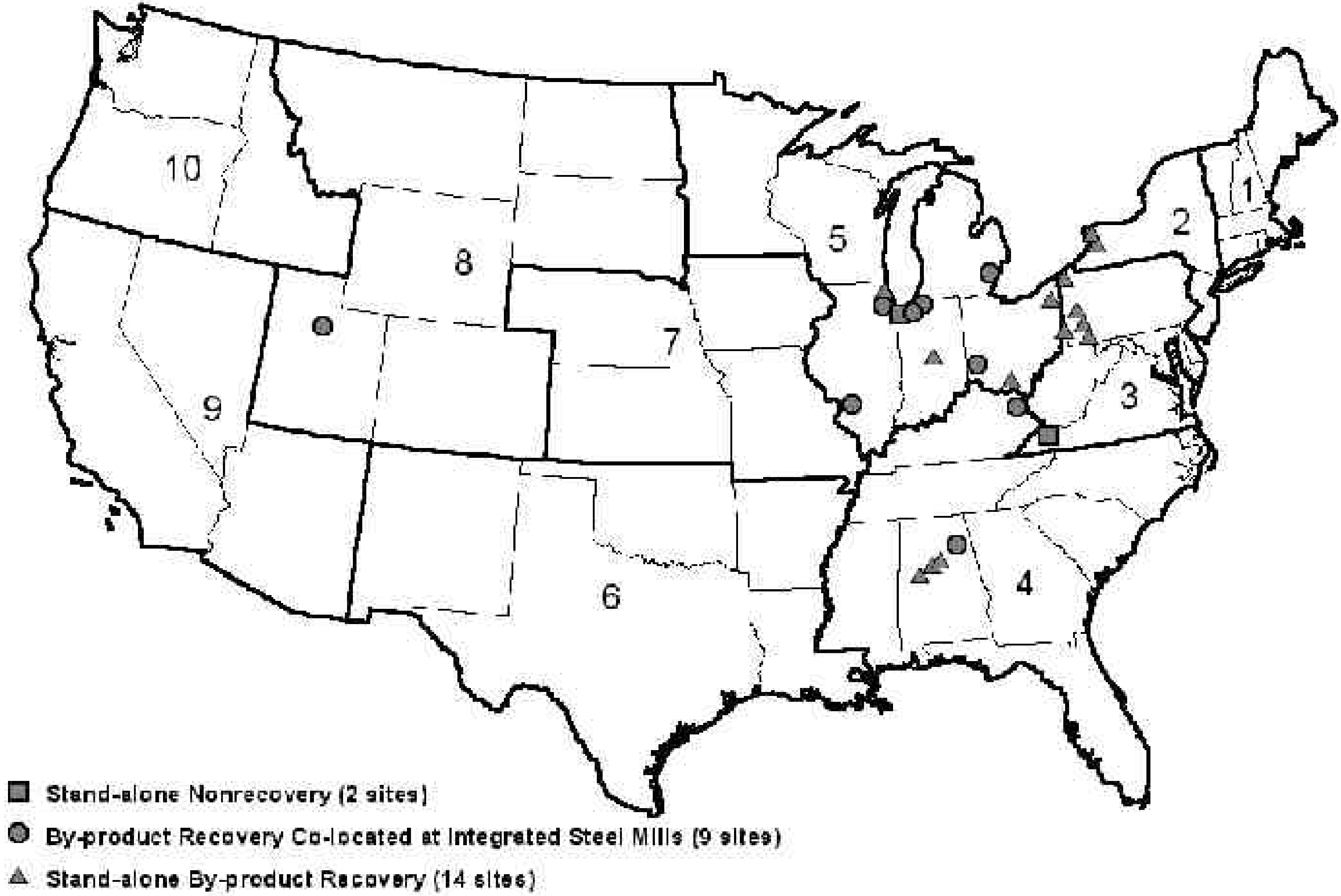


Figure 3-2
Integrated Steel Manufacturing Sites

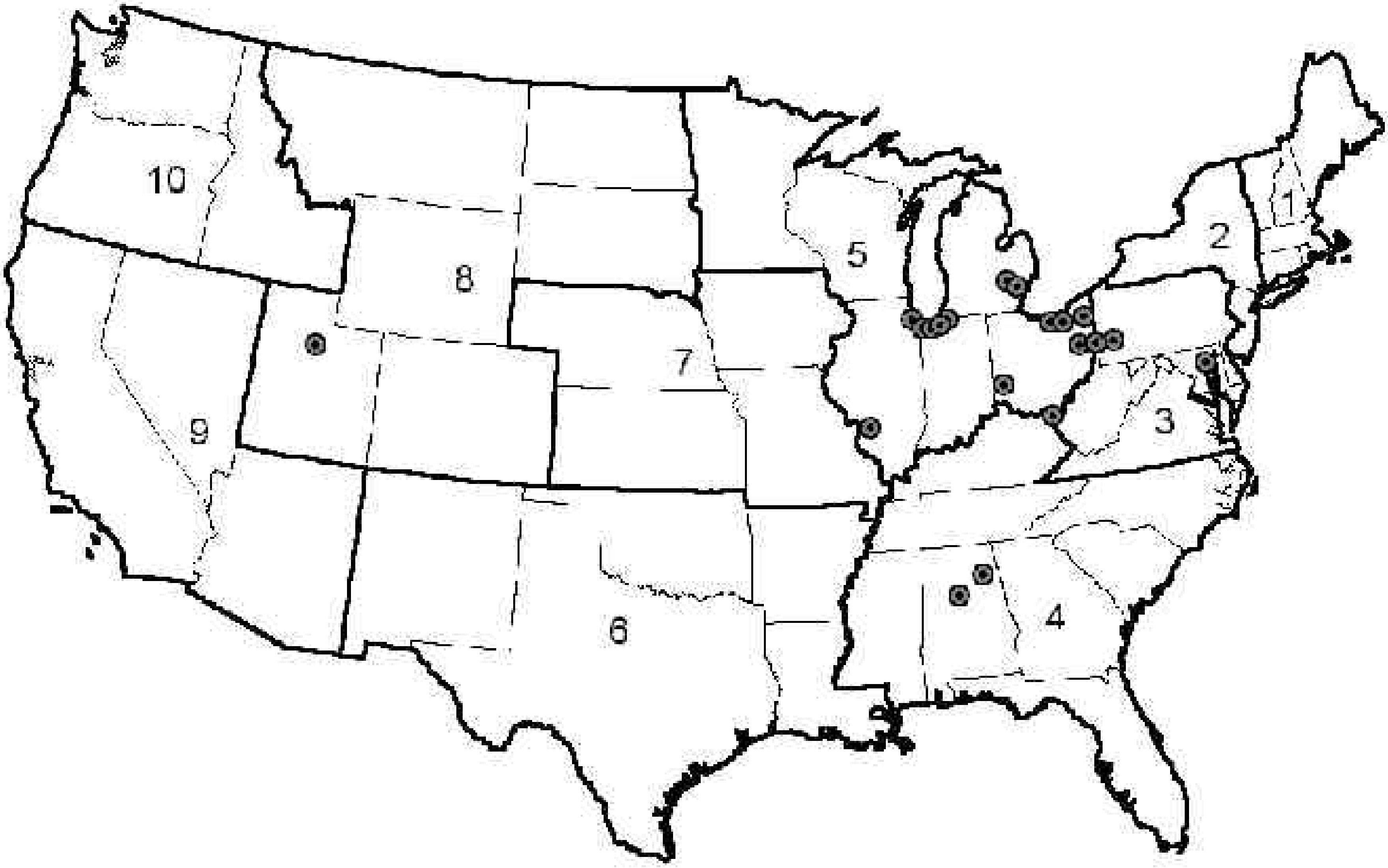
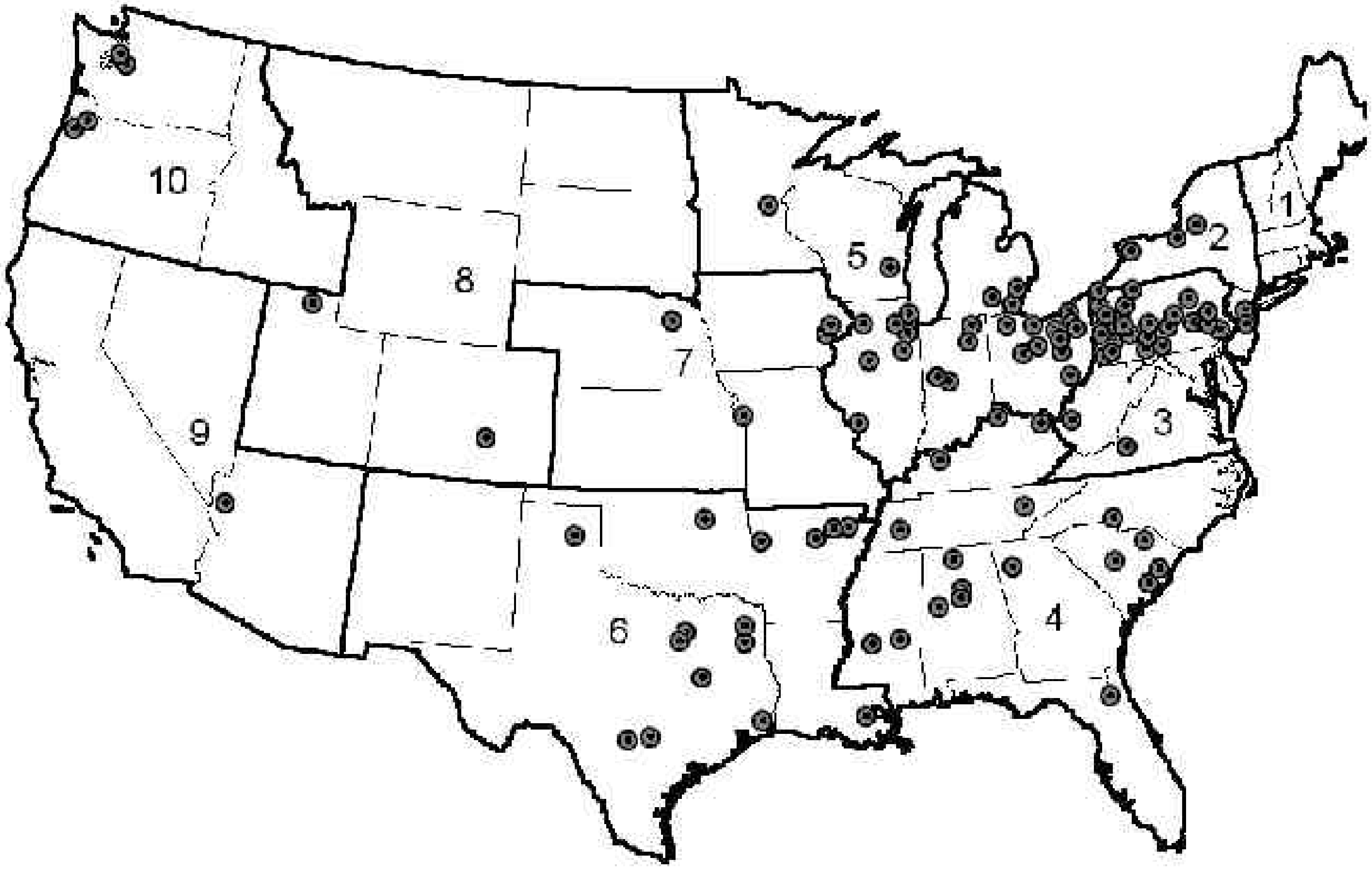


Figure 3-3
Non-Integrated Steel Manufacturing Sites



3.1.2 Assets

EPA collected facility-level and company-level asset data for 190 iron and steel producing sites. A site may not have facility-level information for several reasons, including: the company may not record assets at the facility level, the company may keep records for some facilities on a combined basis, or the mill may have changed ownership. Table 3-1 summarizes the minimum, maximum, average and total facility-level assets in 1997 for those sites that do record such data at this level. The differences among the site types is evident. Integrated, non-integrated, and stand-alone sites average $423, $162, and $69 million in non-current assets respectively. In the aggregate, cash forms roughly 5, 21, and 22 percent of non-current assets.

3.1.3 Capital Investment

To examine capital investment, EPA determined capital intensity at the site-level for each facility surveyed in the iron and steel industry for the year 1997. Capital intensity is calculated by dividing the net value of fixed assets at the site by the number of employees at the site. The average capital intensity for facilities belonging to sites classified as integrated is $151,682, while facilities classified as non-integrated show an average capital intensity of $328,387 (Table 3-2). Facilities classified as stand-alone exhibit an average capital intensity of $427,415. The maximum capital intensity for non-integrated sites is $3,068,880. EPA found that the higher the capital intensity, the newer the facility. Fixed assets are greater for new facilities than for older facilities because newer facilities show less depreciation. Larger fixed assets per employee convey a larger capital intensity.

3.1.4 Value of Shipments

EPA collected facility-level data for value of shipments for iron and steel producing sites for the years 1995, 1996, and 1997. Tables 3-3 through 3-5 describe the product codes in the EPA survey as well as Census and American Iron and Steel Institute product codes for reference (DOC, 1998; AISI, 1995). Table 3-6 illustrates this data by EPA Survey product code. Product codes forty-four through forty-six exceed all other values for shipments by far for each year. Hot-rolled sheet and strip and cold-rolled sheet and strip are represented by product codes forty-four and forty-five respectively. Product code forty-six is

Table 3-1

1997 Assets by Site ($ Millions)

	Integrated Iron and Steel Producers			
	Minimum	Maximum	Average	Total
Current Assets (Cash):	($1,412.34)	$856.32	$28.53	$941.34
Inventories:	$0.04	$485.57	$113.70	$4,320.59
Non-Current Assets:	$0.02	$3,108.81	$422.72	$16,063.33
	Non-Integrated Iron and Steel Producers			
	Minimum	Maximum	Average	Total
Current Assets (Cash):	$0.38	$253.76	$36.17	$2,242.43
Inventories:	$0.93	$129.74	$38.74	$2,517.94
Non-Current Assets:	$1.39	$1,294.29	$161.62	$10,828.26
	Stand-Alone Iron and Steel Producers			
	Minimum	Maximum	Average	Total
Current Assets (Cash):	($0.28)	$101.77	$16.73	$1,003.56
Inventories:	$0.06	$119.43	$17.69	$1,167.31
Non-Current Assets:	$1.03	$435.52	$69.06	$4,627.01

Table 3-2

1997 Capital Intensity for Sites in the Iron and Steel Industry (Value of Fixed Assets per Employee)

Site Classification	Capital Intensity: Minimum	Maximum	Average
Integrated	$36	$557,594	$151,682
Non-Integrated	$8,984	$3,068,880	$328,387
Stand-Alone	$22,234	$8,460,500	$427,415

Table 3-3

Carbon Steel Product Groups by EPA Survey Code

EPA Survey Code	Census Code	Census and Survey, Appendix A (Product Categories) Description	AISI Product Description
30	33122 11	Ingots	Ingots and steel for casting *
	33122 13	Blooms, billets, sheet bars, tin mill bars, tube rounds, and skelp	Blooms, slabs, billets
	33122 20	Slabs	
31	33122 19	Wire rods	Wire Rods
32		Structural shapes:	Structural shapes (3" & over) *
	33124 15	Wide flange	
	33124 17	Standard (heavy)	
	33124 18	Sheet piling and bearing piles	Steel piling *
33	33124 13	Plates (cut lengths)	Plates - Cut Lengths
	33124 14	Plates (in coils)	Plates - In Coils
34	3312C --	Rails, wheels, and track accessories	Total Rails and Accessories * (Standard, All other and Railroad accesories)
35		Bars:	Bars -
	33124 22	Hot rolled, except concrete reinforcing	- Hot rolled
	33124 24	Light structurals, under 3 inches	- Size light shapes
36	33124 26	Bars (Concrete reinforcing)	Bars - Reinforcing
37	33168 11	Bars (Cold rolled)	Bars - Cold finished
38		Pipe:	Pipe and Tubing - *
	33170 27	Structurals	- Structural
	33170 29	Miscellaneous, including standard pipe	- Standard Pipe
			- Pipe for piling
39	33170 19	Pipe (Oil country goods)	Pipe - Oil country goods
40	33170 14	Pipe (Line)	Pipe and tubing - Line *
	33170 15		
41		Pipe (Mechanical and Pressure)	Pipe and tubing - *
	33170 21		- Mechanical
	33170 22		- Pressure
	33170 23		

Table 3-3 (continued)

EPA Survey Code	Census Code	Census and Survey, Appendix A (Product Categories) Description	AISI Product Description
42		Wire:	Wire-Drawn and/or Rolled *
	33155 01	Flat wire	
	33155 02	Under 1.5 mm in diameter	
	33155 03	1.5 mm or above in diameter	
	33155 04	Under 1.5 mm in diameter	
	33155 05	1.5 mm or above in diameter	
	33155 06	Other shape wire	
		Plated or coated with zinc:	
		Round wire:	
	33155 13	Under 1.5 mm in diameter	
	33155 14	1.5mm or above in diameter	
	33155 15	Other shape wire, including flat	
		Other coated wire:	
	33155 17	Flat wire	
	33155 18	Round wire	
	33155 21	Other shape wire	
		Wire products:	
	33152 21	Nails and staples	
	33159 51	Barbed and twisted wire	
	33156 21	Wire fence, woven and welded	
	33159 55	Bale ties	
	33151 13	Wire rope and cable	
		Wire strand:	
	33151 33	For prestressed concrete	
	33151 35	Other	
	33157 71	Woven wire netting	
43		Tin mill products:	Tin mill products - *
	33123 24	Black plate	Black plate
	33123 26	Electrolytic and hot dipped tin plate	Tin plate
	33123 28	Tin free steel	Tin free steel
	33123 29	All other tin mill products, including short ternes and foil	Tin coated sheets
44	33123 11	Sheet and strip (Hot rolled)	Sheets - Hot Rolled
	33123 19		Strip - Hot rolled
45	33167 11	Sheet and strip (Cold rolled)	Sheets - Cold Rolled
	33167 15		Strip - Cold rolled
46	33123 13	Sheet and strip (Galvanized - hot dipped)	Sheets & Strip - Galvanized - Hot dipped

Table 3-3 (continued)

EPA Survey Code	Census Code	Census and Survey, Appendix A (Product Categories) Description	AISI Product Description
			Electrolytic
48	33123 18	Sheet and strip (All other metallic coated, including long ternes)	Sheet & Strip - All other metallic coated *
49	33123 17	Sheet and strip (Electrical)	Sheets & Strip - Electrical

* Variation may exist in Survey code product group(s) because of differences in product descriptions from Census and AISI data.

Table 3-4

Alloy Steel Product Groups by EPA Survey Code

EPA Survey Code	Census Code	Census and Survey, Appendix A (Product Categories) Description	AISI Product Description
50	33122 31	Ingots	Ingots and steel for casting *
	33122 37	Blooms, billets, sheet bars, rounds, and skelp	Blooms, slabs, billets
	33122 41	Slabs	
51	33122 39	Wire rods	Wire Rods
52	33124 33	Plates, cut lengths	Plates - Cut Lengths
	33124 36	Plates, in coils	Plates - In Coils
	33124 38	Structural shapes, 3 inches and under	
53	33124 41	Bars (Hot rolled)	Bars - Hot rolled
54	33168 31	Bars (Cold finished)	Bars - Cold finished
55	33124 48 33124 49	Tool steel	Tool Steel
56	33170 48	Pipe (miscellaneous, including standard and structural)	Pipe and tubing - Standard Pipe, Structural *
57	33170 32	Pipe (oil country goods)	Pipe and tubing - Oil country goods
58	33170 43	Pipe (mechanical and pressure)	Pipe and tubing - Pressure
	33170 45		Pipe and tubing - Mechanical
59	33155 37	Wire	Wire-Drawn and/or Rolled *
60	33123 31	Sheet and strip (hot rolled)	Sheets - Hot rolled
	33123 39		Strip - Hot rolled
61	33167 31	Sheet and strip (cold rolled and finished)	Sheets - Cold rolled
	33167 35		Strip - Cold rolled
62	33123 35	Sheet and strip (galvanized, hot dipped)	Sheets & Strip - Galvanized - Hot dipped
63	33123 37	Sheet and strip (all other metallic coated, including electrolytic)	Sheets & Strip - - All other metallic coated - Electrolytic

* Variation may exist in Survey code product group(s) because of differences in product descriptions from Census and AISI data.

Table 3-5

Stainless Steel Product Groups by EPA Survey Code

EPA Survey Code	Census Code	Census and Survey, Appendix A (Product Categories) Description	AISI Product Description
70	33122 51	Ingots	Ingots and steel for casting *
			Blooms, slabs, billets
70	33122 56	Blooms, billets, slabs, sheet bars, tube rounds, and skelp	
71	33122 59	Wire rods	Wire Rods
		Finished products:	
72	33124 53	Plates and structurals	Total Shapes and Plates *
		Bars:	
73	33124 61	Hot rolled	Bars - Hot rolled
74	33168 51	Cold finished	Bars - Cold finished
		Pipe and tubes:	
		Pressure tubing:	Pipe and tubing - Pressure *
75	33170 61	Seamless	
75	33170 62	Welded	
		Mechanical tubing:	Pipe and tubing - Mechanical *
75	33170 63	Seamless	
75	33170 64	Welded	
75	33170 65	Other pipe and tubes	
		Wire:	Wire - Drawn and/or Rolled *
		Round wire:	
76	33155 52	Under 0.75 mm in diameter	
76	33155 53	0.75 mm to under 1.5 mm in diameter	
76	33155 54	1.5 mm and above in diameter	
76	33155 57	Other shape wire, including flat wire	
		Sheet and strip:	
77	33123 57	Hot rolled	Sheets and Strip - Hot rolled *
78	33167 57	Cold rolled	Sheets and Strip - Cold rolled *

* Variation may exist in Survey code product group(s) because of differences in product descriptions from Census and AISI data.

Table 3-6

Value of Shipments by Product Code ($ Millions)

Product Code	1995	1996	1997
Coke and Coke Byproduct			
10	$1,212	$1,209	$1,120
20	$48	$48	$44
21	$52	$46	$40
22	$53	$65	$55
23	$12	$16	$21
24	$7	$8	$7
25	$13	$13	$15
Carbon Steel Products			
30	$1,410	$1,449	$1,477
31	$1,478	$1,391	$1,521
32	$2,295	$2,544	$2,601
33	$2,019	$1,932	$1,977
34	$318	$346	$404
35	$2,190	$2,060	$2,435
36	$1,026	$1,096	$1,279
37	$37	$34	$37
38	$271	$313	$282
39	$388	$523	$639
40	$330	$293	$343
41	$540	$517	$597
42	$361	$336	$297
43	$2,200	$2,294	$2,340
44	$9,689	$9,423	$9,579
45	$7,006	$7,339	$7,672
46	$5,621	$5,981	$6,404
47	$2,245	$2,325	$2,364
48	$1,192	$1,141	$1,146
49	$263	$641	$613
Alloy Steel Products			
50	$877	$1,002	$1,043
51	$85	$90	$117
52	$629	$671	$679
53	$826	$817	$931
54	$152	$135	$150
55	$46	$39	$45
56	$17	$20	$23
57	$423	$373	$554
58	$469	$549	$506
59	$22	$25	$34
60	$203	$194	$323
61	$130	$138	$147
62	$52	$67	$231

Table 3-6 (continued)

Product Code		1995	1996	1997
63		$176	$185	$185
Stainless Steel Products				
70		$159	$296	$351
71		$82	$68	$80
72		$381	$243	$255
73		$268	$259	$224
74		$288	$271	$289
75		$11	$13	$10
76		$77	$73	$77
77		$498	$341	$350
78		$2,477	$2,774	$2,806
Other Products				
90	Sinter	$22	$18	$2
92	Pig Iron/ Hot Metal	$39	$46	$44
93	Scrap	$12	$14	$14
94	Conversion Costs	$12	$14	$10
98	Aggregate Costs	$26	$26	$30
99	Miscellaneous	$236	$252	$24
Total:		$50,973	$52,395	$54,841

galvanized hot-dipped sheet and strip. From 1995 to 1997, the total value of shipments increased by approximately $2 million each year. Additionally, Table 3-7 compares shipment data among integrated, non-integrated, and stand-alone sites. Again, the relative scale of integrated, non-integrated, and stand-alone sites is apparent.

3.1.5 Exports

Table 3-8 displays the value of shipments classified as exports from 152 iron and steel producing sites (only the detailed survey asks about exports). The total value of shipments exported by integrated sites decreases dramatically from 1995 to 1996 by over 640 million dollars. From 1996 to 1997, the value of exports increase to over 1,000 million dollars. Non-integrated sites illustrate a different perspective. While the average value of shipments exported by non-integrated sites increases by over a million dollars, the total value of exports increases by almost 150 million dollars. Stand-alone facilities were more stable than integrated and non-integrated sites. For stand-alone facilities, 1996 was the lowest surveyed year for exports with approximately 146 million dollars and 1997 was the high point with 156 million dollars.

3.1.6 "Captive Facilities"

A site is classified as "captive" when a certain percentage of its production is shipped to other sites under the same ownership. EPA collected production data for 1995, 1996 and 1997 for 152 sites (only the detailed survey asks the applicable questions, see Table 3-9). For these years, between seven and nine sites shipped all of their products to sites under the same ownership, i.e., approximately one percent of total industry production. These sites exist solely to provide products to other sites owned by the same company. Sites that shipped more than fifty percent of their production to sites under the same ownership account for approximately four percent of total industry production. There were 16 sites that shipped more than half of their production to sites under the same ownership in 1995, 18 sites in 1996, and 19 sites in 1997. Generally, however, production at most sites is not dependent on other sites under the same ownership in the iron and steel industry. For the most part, sites producing iron and steel output are independent producers even though they may be owned by the same company.

Table 3-7

Value of Shipments ($ Millions)

	1995	1996	1997
Integrated Sites			
Average:	$728	$707	$704
Total:	$28,386	$28,262	$28,874
Non-Integrated Sites			
Average:	$221	$242	$246
Total:	$13,249	$15,015	$16,704
Stand-Alone Sites			
Average:	$141	$134	$134
Total:	$9,338	$9,118	$9,263
Total of All Sites:	$50,973	$52,395	$54,841

Table 3-8

Value of Shipments Exported (Partial data) ($ Millions)

	1995	1996	1997
Integrated Sites			
Average:	$77	$45	$51
Total:	$1,534	$892	$1,024
Non-Integrated Sites			
Average:	$11	$10	$12
Total:	$467	$460	$615
Stand-Alone Sites			
Average:	$9	$9	$10
Total:	$150	$146	$156
Total of All Sites:	$2,150	$1,498	$1,796

Note: Data includes only "Detailed" survey information. The pertinent questions were not asked in the "Short" survey.

Table 3-9

Percentage and Value of Industry Production Shipped to Sites Under the Same Ownership (Partial Data)
($ Millions)

Percentage of Site Production Shipped to Sites Under Same Ownership	Number of Sites			Value of Total Industry Production Shipped to Sites Under Same Ownership			Percentage of Total Industry Production Shipped to Sites Under Same Ownership		
	1995	1996	1997	1995	1996	1997	1995	1996	1997
100%	7	8	9	$527	$515	$588	1.03%	0.98%	1.06%
>90%	10	11	12	$978	$896	$982	1.91%	1.70%	1.78%
>75%	12	14	15	$1,659	$1,678	$1,797	3.25%	3.18%	3.25%
>50%	16	18	19	$2,239	$2,148	$1,971	4.38%	4.07%	3.57%

Note: Data includes only "Detailed" survey information. The pertinent questions were not asked in the "Short" survey.

3.1.7 Employment

The total number of employees at iron and steel producing sites surveyed by EPA for the year 1997 is 144,981. Integrated facilities employ the most workers with 79,802 people. Non-integrated and stand-alone facilities employ 44,825 and 20,354, respectively for a total of about 145,000 employees in the regulated community. The average number of employees at integrated sites exceed the average number of employees at stand-alone sites by more than a factor of six. See Table 3-10 for a detailed look at employment data for sites surveyed by EPA.

3.2 COMPANY-LEVEL INFORMATION

3.2.1 Companies in the Sample

The companies in the iron and steel industry fall into three coarse categories, similar to those used for classifying the sites (Section 2.2):

- Integrated. Traditionally, integrated steel companies performed all basic steelmaking operations from cokemaking through finishing. Today, the term refers companies owning blast furnaces or BOFs, many of the companies having closed their cokemaking and sintering operations.

- Non-integrated. Also known as "minimills," these companies have EAFs and do not have blast furnaces or BOFs. Note that the reverse is not true. For example, Bethlehem Steel—an integrated producer—owns EAF based plants in Coatsville, PA and Steelton, PA.

- Stand-alone. Companies with stand-alone sites have no melting capability. This category of companies is more heterogeneous than the first two categories because stand-alone sites cover a wide range in operations from cokemaking to tube and pipe manufacture.

Table 3-10

Number of Employees in 1997

	Minimum	Maximum	Average	Total
Integrated Sites	54	8,426	1,900	79,802
Non-Integrated Sites	20	3,099	650	44,825
Stand-Alone Sites	16	1,652	283	20,354

3.2.2 Type of Ownership

The 188 sites in the iron and steel database are owned by 115 companies. The global nature of the industry is illustrated by 22 sites with foreign ownership; four of these sites are joint entities with U.S. partners. Twelve other sites are joint entities with only U.S. partners. Excluding joint entities and foreign ownership, the data base contains 85 U.S. companies. Among these 85 U.S. companies,

- 73 are C corporations
- 8 are S/limited liability corporations
- 3 are limited partnerships
- 1 is a utility, public charitable trust

Approximately 55 percent of these 85 U.S. companies are privately owned; the EPA Survey is EPA's only source of financial information for these privately-held firms.

3.2.3 Number of Sites per Company

The public may believe the “Steel Industry” consists only of big multi-site firms; however, the vast majority of the surveyed population are single site firms. In the surveyed population, only 3 firms have 10 or more sites and 10 firms have from 5 to 9 sites. Not including joint entities, the most common arrangement is a one site company (i.e., both the median and mode firms have one site).

3.2.4 Financial Characteristics

EPA examined three data sources for financial characteristics for the iron and steel industry:

- Industry (AISI)
- Census (Quarterly Report for Manufacturing, Mining, and Trade Corporations)
- EPA Survey

Figure 3-4 and Table 3-11 summarize the net cash flow and depreciation from 1986 to 2000 from AISI data. These data represent companies that account for about two-thirds of the raw steel production in the U.S. Depreciation is relatively stable, ranging from $1.3 billion to $2.2 billion per year. Net cash flow, on the other hand, swings widely from a loss of $2.8 billion in 1986 to a profit of $3.4 billion in 1993. A comparison of 1992 and 1993, when the industry went from a loss of $2.6 billion to a profit of $3.4 billion illustrates how rapidly conditions can change. Moreover, net cash flow hovers around the three billion mark till 1998, after which it declines to $1.1 billion. Figure 3-5 overlays capacity utilization rate (Figure 2-4) with cash flow from Figure 3-4. There is a general concordance between the time series, with the exception of 1992 and 2000 when cash flow continued to decline while capacity utilization rate recovered. The increasing capacity utilization rate, however, is a factor in the sharp increase in cash flow seen in 1993. The years 1986 and 1992 are nadirs in the series. A six-year earnings cycle seems too short, however, given the 1992 to 1998 data. The forecasting method used to project facility earnings, then, needs to address this cyclicality and the cycle should be no shorter than six years and possibly seven to eight years in length (see Section 4).

Figure 3-4

Net Cash Flow and Depreciation for the Steel Industry in the United States: 1986-2000

Source: AISI, 2000, 1998, 1995

Table 3-11

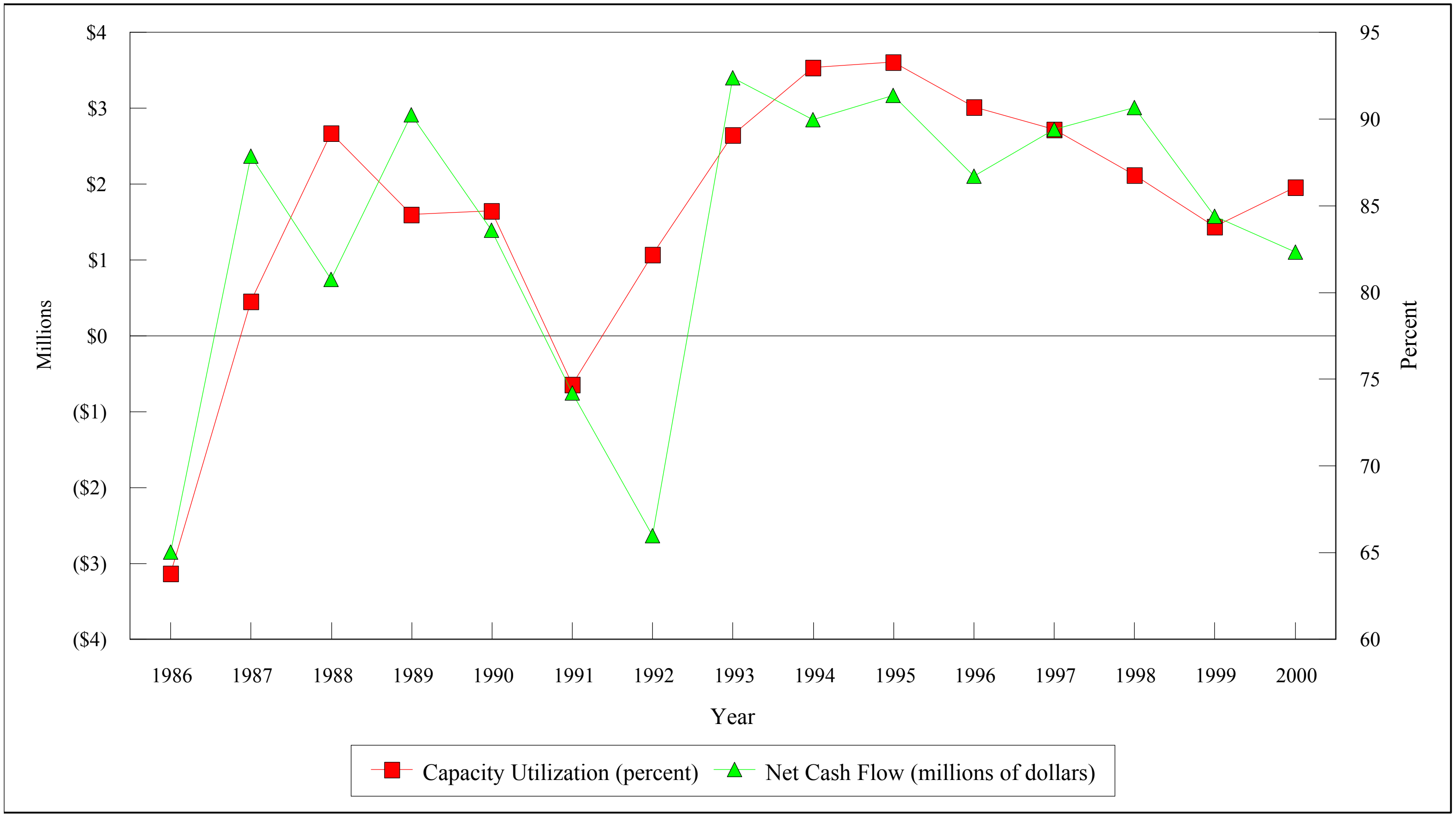
Industry Cash Flow (in Millions)

Year	Depreciation, Depletion & Amortization	Net Income	Cash Flow (Net Income Plus Depreciation)
1986	$1,301	($4,150)	($2,849)
1987	$1,294	$1,077	$2,371
1988	$1,311	($567)	$744
1989	$1,320	$1,597	$2,916
1990	$1,337	$54	$1,391
1991	$1,286	($2,042)	($756)
1992	$1,435	($4,068)	($2,633)
1993	$1,532	$1,870	$3,402
1994	$1,564	$1,285	$2,849
1995	$1,636	$1,534	$3,170
1996	$1,664	$442	$2,106
1997	$1,695	$1,031	$2,726
1998	$1,899	$1,110	$3,009
1999	$2,044	($464)	$1,580
2000	$2,186	($1,085)	$1,102

Source: AISI, 2000, 1998, 1995

Figure 3-5

Steelmaking Capacity Utilization and Cash Flow in the United States: 1986-2000



Source: AISI, 2000, 1998, 1995

Table 3-12 presents income statement data from the Quarterly Financial Report (QFR) for SIC Industry Groups 331, 332, and 339. It therefore includes more industry operations than those covered in the EPA Survey but excludes nonferrous industries included in Primary Metal Industries (SIC 33). The cash flow information for the four quarters of 1999 shows information consistent with that in Figure 3-5, i.e, an increase in the second quarter and a steady decline thereafter. The separation of the data into companies with assets under $25 million or $25 million or more highlights some differences between the two groups. The smaller companies show higher rates of return on assets and equity than the larger companies. The data in Table 3-12 do not show a dramatic effect on financial conditions. This is because the data include businesses that use semi-finished products as an input. That is, the increase in lower priced imports would improve their financial condition by lowering input costs. This mix of companies indicates that the QFR data are too aggregated to use in the forecasting models (see Adams, 1999; Bagsarian, 1999).

Table 3-13 presents balance sheet data for the same set of companies. The smaller companies show higher current ratios than the larger companies but lower absolute amounts of working capital. (The first variable—current ratio—is current assets divided by current liabilities. The second variable—working capital—is current assets minus current liabilities.) Financial analysts sometimes use a combination of financial ratios to gauge the health of a company. The baseline condition of the industry is discussed in more detail in the economic methodology, Section 4.

3.3 REFERENCES

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Table 3-12

Income Statement Data for Corporations Included in SIC Industry Groups 331, 2, 9, and 333-6: Iron and Steel (in $Millions)

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	1999 Total	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	2000 Total
Iron and Steel										
Income (or loss) from operations	$415	$853	$607	$555	$2,430	$920	$1,137	$667	($9)	$2,715
Income(or loss) before taxes	$47	$573	$283	$195	$1,098	$621	$371	$269	($1,060)	$201
Income(or loss) after taxes	($36)	$361	$99	$31	$455	$391	$166	$77	($1,309)	($675)
Net income retained in business	($164)	$180	($65)	($122)	($171)	$212	($53)	($66)	($1,454)	($1,361)
Retained earnings at end of quarter	$7,376	$7,462	$7,450	$8,359	$30,647	$8,131	$7,524	$7,610	$7,138	$30,403
Iron & Steel Assets Under $25 Mil										
Income (or loss) from operations	$63	$136	$63	$92	$354	$91	$182	$78	$34	$385
Income(or loss) before taxes	$46	$124	$46	$72	$288	$84	$161	$64	($43)	$266
Income(or loss) after taxes	$42	$117	$39	$56	$254	$73	$142	$62	($58)	$219
Net income retained in business	$28	$65	($16)	$30	$107	$21	$93	$7	($82)	$39
Retained earnings at end of quarter	$1,538	$1,399	$963	$1,441	$5,341	$1,367	$1,394	$1,256	$1,196	$5,213
Iron & Steel 331, 2 and 9 Assets Over $25 Mil										
Income (or loss) from operations	$351	$716	$544	$463	$2,074	$830	$955	$589	($43)	$2,331
Income(or loss) before taxes	$1	$449	$238	$123	$811	$537	$210	$206	($1,017)	($64)
Income(or loss) after taxes	($78)	$244	$60	($25)	$201	$318	$24	$16	($1,251)	($893)
Net income retained in business	($195)	$104	$37	($142)	($196)	$193	($127)	($73)	($1,040)	($1,047)
Retained earnings at end of quarter	$5,838	$6,063	$6,486	$6,918	$25,305	$6,764	$6,130	$6,354	$5,941	$25,189

Source: Quarterly Financial Report on Manufacturing, Mining and Trade Corporations, US Census

Table 3-13

Balance Sheet Data for Corporations Included in SIC Industry Groups 331, 2, 9, and 333-6: Iron and Steel (in $ Millions)

	1999: 1Q	2Q	3Q	4Q	2000: 1Q	2Q	3Q	4Q
Iron and Steel								
Total cash on hand and in U.S. banks	$1,316	$1,316	$1,378	$1,283	$1,028	$1,296	$1,069	$1,296
Total cash	$3,044	$3,053	$3,183	$2,801	$2,308	$2,370	$2,074	$2,481
Total current assets	$26,376	$26,378	$27,644	$28,309	$29,018	$29,742	$28,568	$27,772
Net property, plant, and equipment	$33,819	$33,767	$35,036	$37,165	$38,306	$38,292	$38,114	$37,844
Total Assets	$73,170	$72,680	$76,270	$81,352	$83,582	$83,276	$81,831	$81,476
Total current liabilities	$14,899	$14,463	$15,506	$16,800	$17,802	$17,704	$17,380	$16,942
Total liabilities	$49,240	$48,890	$51,677	$55,632	$58,025	$58,504	$57,406	$57,360
Stockholders' equity	$23,930	$23,790	$24,592	$25,720	$25,557	$24,772	$24,425	$24,115
Total Liabilities and Stockholders' Equity	$73,170	$72,680	$76,270	$81,352	$83,582	$83,276	$81,831	$81,476
Current Assets	1.77	1.82	1.78	1.69	1.63	1.68	1.64	1.64
Working Capital	$11,477	$11,915	$12,138	$11,509	$11,216	$12,038	$11,188	$10,830
Iron & Steel Assets Under $25 Mil								
Total cash on hand and in U.S. banks	$247	$248	$158	$252	$220	$227	$211	$297
Total cash	$277	$291	$230	$354	$307	$313	$264	$382
Total current assets	$1,697	$1,698	$1,574	$1,916	$1,725	$1,918	$1,673	$1,654
Net property, plant, and equipment	$1,285	$1,131	$1,087	$1,160	$1,087	$1,145	$939	$964
Total Assets	$3,183	$2,996	$2,918	$3,207	$2,928	$3,259	$2,777	$2,779
Total current liabilities	$790	$730	$937	$906	$852	$948	$816	$789

Table 3-13 (continued)

	1999: 1Q	2Q	3Q	4Q	2000: 1Q	2Q	3Q	4Q
Stockholders' equity	$1,871	$1,645	$1,305	$1,653	$1,578	$1,665	$1,463	$1,445
Total Liabilities and Stockholders' Equity	$3,183	$2,996	$2,918	$3,207	$2,928	$3,259	$2,777	$2,779
Current Assets	2.15	2.33	1.68	2.11	2.02	2.02	2.05	2.10
Working Capital	$907	$968	$637	$1,010	$873	$970	$857	$865
Iron & Steel 331, 2 and 9 Assets Over $25 Mil								
Total cash on hand and in U.S. banks	$1,072	$1,069	$1,222	$1,031	$814	$1,073	$861	$1,000
Total cash	$2,768	$2,763	$2,953	$2,447	$2,001	$2,057	$1,810	$2,099
Total Receivables	$8,160	$8,185	$8,752	$8,750	$9,657	$9,902	$9,390	$8,592
Total current assets	$24,679	$24,680	$26,070	$26,392	$27,293	$27,824	$26,895	$26,118
Net property, plant, and equipment	$32,533	$32,635	$33,949	$36,005	$37,219	$37,147	$37,175	$36,880
Total Assets	$69,987	$69,684	$73,352	$78,145	$80,653	$80,017	$79,053	$78,696
Total current liabilities	$14,109	$13,733	$14,569	$15,894	$16,950	$16,756	$16,564	$16,153
Total liabilities	$47,928	$47,538	$50,064	$54,077	$56,674	$56,911	$56,091	$56,026
Stockholders' equity	$22,059	$22,146	$23,287	$24,068	$23,979	$23,106	$22,962	$22,670
Total Liabilities and Stockholders' Equity	$69,987	$69,684	$73,352	$78,145	$80,653	$80,017	$79,053	$78,696
Current Assets	1.75	1.80	1.79	1.66	1.61	1.66	1.62	1.62
Working Capital	$10,570	$10,947	$11,501	$10,498	$10,343	$11,068	$10,331	$9,965

Source: Quarterly Financial Report on Manufacturing, Mining and Trade Corporations, US Census

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CHAPTER 4

ECONOMIC IMPACT METHODOLOGY

This section provides a brief overview of the methodology used in the economic impact, regulatory flexibility, and environmental justice analyses. The discussion follows the sequence from the smallest scale (costs for specific configurations of option, subcategory and site) to the largest scale (market analysis):

- cost annualization model, Section 4.1
- site closure model, Section 4.2
- community and national impacts, Section 4.3
- corporate financial distress, Section 4.4
- market model, Section 4.5

The results of these analyses are presented in Chapter 6.

4.1 COST ANNUALIZATION MODEL

The beginning point for all analyses is the cost annualization model, see Figure 4-1. Inputs to the cost annualization model come from three sources—EPA's engineering staff, secondary data, and the 1997 EPA Survey. The capital, one-time non-equipment[1], and operating and maintenance (O&M) costs for incremental pollution control were developed by EPA's engineering staff. The capital cost, a one-time cost, is the initial investment needed to purchase and install the equipment. The one-time non-equipment cost is incurred in its entirety in the first year of the model. The O&M cost is the annual cost of operating and maintaining the equipment; the site incurs it each year.

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[1]A one-time non-equipment cost is best explained by example, such as an engineering study that recommends improved operating parameters as a method of meeting effluent limitations guidelines. One-time non-equipment costs cannot be depreciated because the product is not associated with property that wears out, nor is it an annual expense.

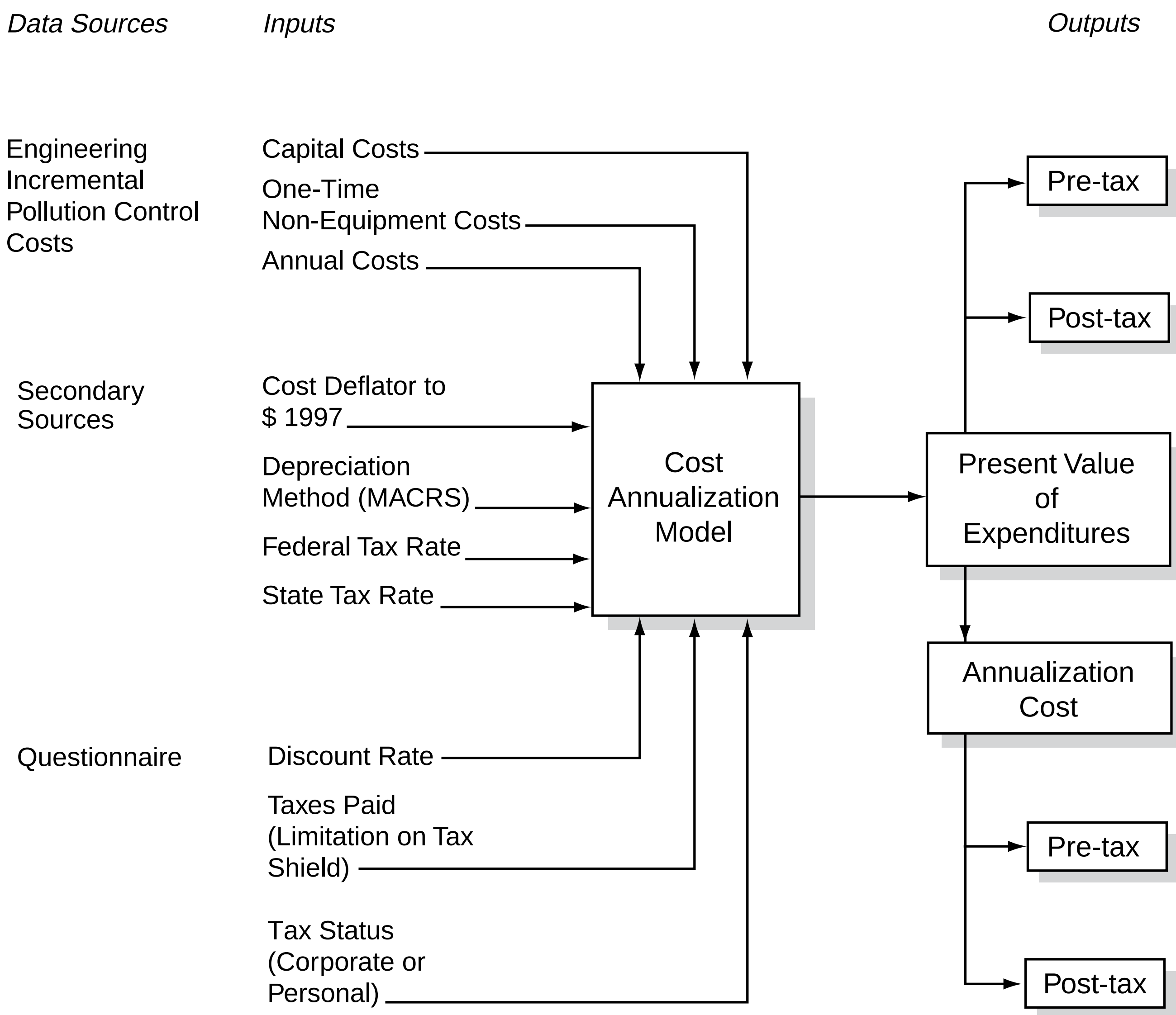

Figure 4-1

Cost Annualization

There are two reasons for the annualization of capital, one-time non-capital, and O&M costs. First, the capital cost is incurred only once in the equipment's lifetime; therefore, initial investment should be expended over the life of the equipment. The Internal Revenue Code Section 168 classifies an investment with a lifetime of 20 years or more but less than 25 years as 15-year property. The cost annualization model uses a 15-year depreciable lifetime for the capital cost. Second, money has a time value so expenditures incurred at the end of the equipment's lifetime or O&M expenses in the future are not the same as expenses paid today. A mid-year depreciation convention is used, i.e., an assumption of a six-month period between purchase of equipment and time of operation. As such, the model covers a 16-year period with a six-month period in the first year and a six-month period in the sixteenth year.

Secondary data provides the average inflation rate from 1987 to 1997 as measured by the Consumer Price Index. The depreciation method used in the cost annualization model is the Modified Accelerated Cost Recovery System (MACRS). MACRS allows businesses to depreciate a higher percentage of an investment in the early years and a lower percentage in the later years. The average inflation rate is used to convert the nominal discount rate to the real discount rate. Tax rates are determined by the national average state tax rate plus the Federal tax rate.

The 1997 EPA Survey data provides a discount rate or interest rate (the weighted average cost of capital or the interest rate supplied by the site). If the site supplied neither a discount rate nor an interest rate, EPA assigned the median discount rate of all sites for this value. Taxable income, or earnings before interest and taxes (EBIT), is also supplied by the EPA Survey. The value of EBIT determines the tax bracket for the site. Average taxes paid is calculated from EPA Survey data using taxes for the years 1995, 1996, and 1997. The model ensures that the tax shield cannot be greater than the average taxes paid in these years. Corporate structure estimates tax shields. A C corporation pays federal and state taxes at the corporate rate, an S corporation or a limited liability corporation pays taxes at the individual rate (since EPA has no way of determining how many individuals receive earnings or their tax rates, these rates are set to zero), and all other entities pay taxes at the individual rate.

A sample cost annualization spreadsheet is located in Appendix A of this document. Section A.3 of Appendix A describes the calculations used to determine annualized costs (before and after taxes) and present value of costs (before and after taxes) in detail.

The cost annualization model calculates the present value of the pre- and post-tax cost streams. Then it calculates the annualized cost based on the site-specific discount rate. Thus, the model calculates four types of compliance costs for each site: present value of expenditures (pre- and post-tax) and annualized cost (pre- and post-tax). The latest year for which financial data is available from the survey is 1997, hence, the model uses 1997 dollars.

The cost annualization model outputs feed into the other economic analyses, see Figure 4-2. From top to bottom, the pre-tax annualized cost for all sites costed provides an initial estimate of the shock to the market model (Section 4.5). An output of the market model is an estimate of the percentage of increased costs that a producer could pass to its customers. The post-tax present value and the cost-pass-through factor are inputs to the site closure model (Section 4.2). The results of the site closure model allow EPA to identify sites with complete site-level data and no confounding factors (e.g., start-up site, captive site, or unusual ownership such as joint entity or foreign ownership) that are projected to close before the regulation is implemented (i.e., for reasons unrelated to the regulation). The site closure model also identifies sites projected to close as a result of the regulation. Direct, regional, and national-level direct and indirect impacts flow from the sites projected to close (Section 4.3). The pre-tax costs are inputs to the corporate financial distress model (Section 4.4), compliance cost share of revenue, and as a refined estimate of the shock to the market model. Pre-tax costs also figure in the cost-effectiveness analysis (see Appendix C; not part of economic achievability).

4.2 SITE CLOSURE MODEL

EPA developed a financial model to estimate whether the additional costs of complying with the final regulation rendered an iron and steel site unprofitable. If so, the site is projected to close as a result of the regulation, leading to site-level impacts such as losses in employment and revenue. Hence, the site financial model is also called the closure model within the report. The model is based on site-specific data from the detailed questionnaire (U.S. EPA, 1998) because such data are not available elsewhere.

In terms of perspective, the closure model focuses on the site. It attempts to answer the question "does it make financial sense to upgrade this site?" using data and methodology available to corporate

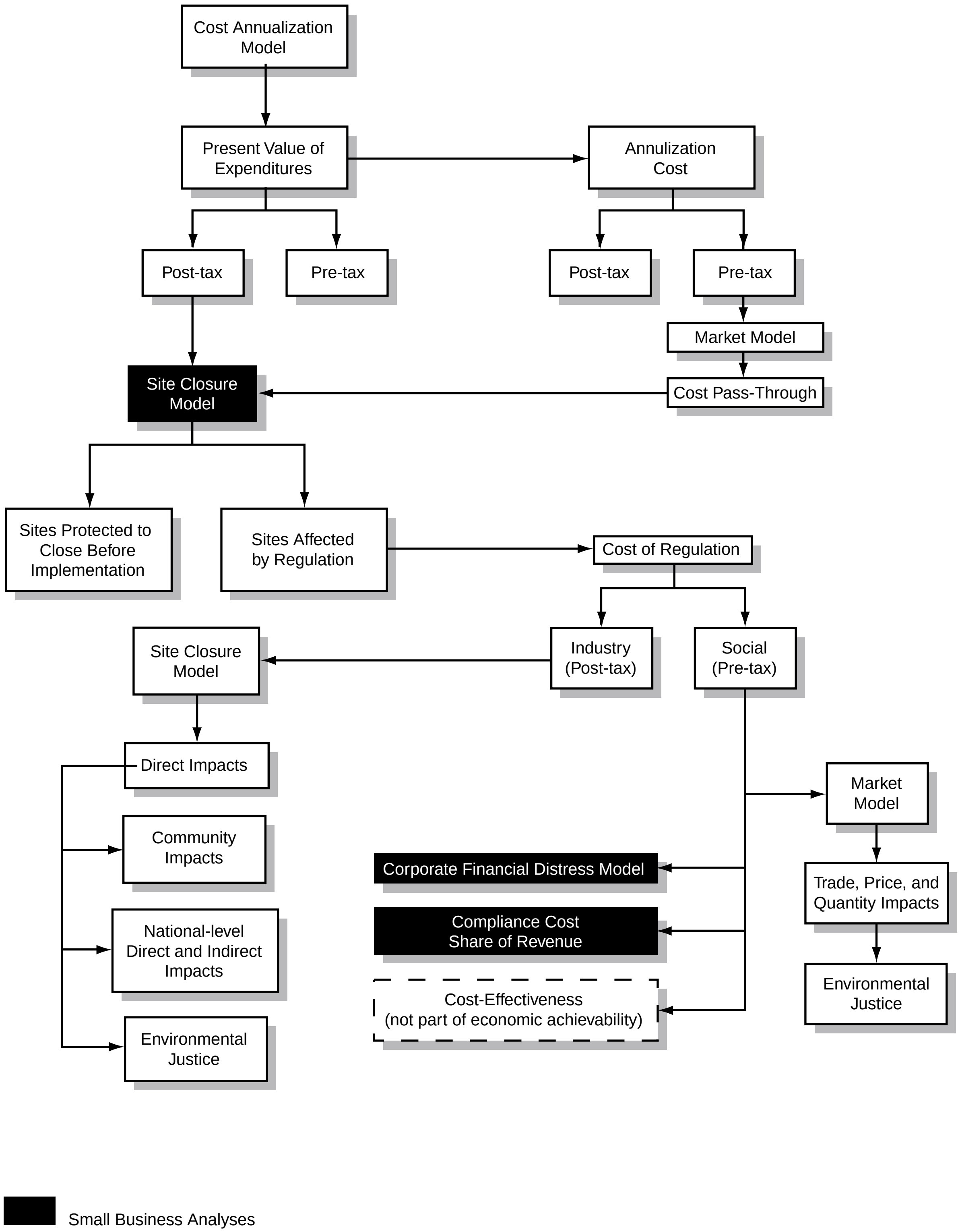

Figure 4-2

Interrelationship Among Cost Annualization and Other Economic Analyses financial analysts. The closure model interacts with the market model (Section 4.5); the latter estimates the industry proportion of costs that the steel manufacturer passes through to its customers via price increases. In contrast, the corporate financial distress model evaluates whether a company could afford to upgrade all of its facilities (Section 4.4). In other words, each model provides a different perspective on the industry and the impacts potentially caused by the effluent limitations guidelines requirements.

The model turns the question "does it make sense to upgrade this site?" into a comparison of future cash flows with and without the regulation. The closure decision is modeled as:

Post-regulatory status = Present value of future earnings
- (Present value of after-tax incremental pollution control costs * (1-percent cost pass-through))

The model calculates the long-term effects on earnings reduced by the added pollution control costs. If the post-regulatory status is less than zero, it does not make economic sense for the site owner to upgrade the site. Under these circumstances, the site is projected to close.[2] Although simple in concept, the model incorporates numerous choices, including:

- Whether or not to include salvage value
- Net income or cash flow for the basis of projecting future earnings
- Time frame for consideration

Section 4.2.1 reviews the decisions and their bases for the steel site financial model. Section 4.2.2 describes the data preparation and forecasting methods used in this analysis. Section 4.2.3 presents EPA's methodology for determining site closure when evaluating multiple approaches for estimating future earnings.

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[2] When a site is liquidated, EPA assumes that it no longer operates and that closure-related impacts result. In contrast, facilities that are sold because a new owner presumably can generate a greater return are considered *transfers*. Transfers cause no closure-related impacts, even if the transfer was prompted by increased regulatory costs. Transfers are not estimated in this analysis.

4.2.1 Assumptions and Choices

4.2.1.1 Salvage Value

The closure decision equation can be modified to include consideration of the salvage value of the site. That is, the post-regulatory status is zero if the present value of post-regulatory earnings *exceeds the salvage value of the site*.

For the iron and steel industry, however, EPA determined that it was not appropriate to include salvage value in the site financial model. First, individual pieces of equipment tend to be designed for specific sites due to their scale. Because it is highly unlikely that individual components of a site could be sold, there is no market value to fixed assets.[3] An exception is if the entire plant could be transferred to a new location, as was done for Tuscaloosa Steel. In these cases, the salvage value is still zero because the owner paid to break down, transport, and reassemble the site elsewhere. Second, it is not appropriate to calculate a salvage value based solely on current assets because the value of cash, cash-equivalents, and inventory are sufficiently liquid that the owner would not base a long-term decision on them. (That is, an owner would not liquidate the site because it shows a relatively high cash position on the balance sheet. The cash could be transferred to other corporate operations without such a drastic step as closing down operations.)

Third, excluding salvage value brings the site financial model into greater consistency with econometric modeling approaches. That is, a site is assumed to remain in operation as long as its revenues meet or exceed its operating costs. Sunk—i.e., capital—costs are not considered.

4.2.1.2 Net Income Versus Cash Flow

EPA examined two alternatives for estimating the present value of future plant operations:

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[3]Bethlehem Steel, for example, could have torn down everything at its home town location along the Lehigh River but chose to develop part of the site into an industrial museum (Wright, 1999). Liquidating part or all of the site was not mentioned as a possibility.

- Net income from all operations, calculated as revenues less operating costs; selling, general, and administrative expenses; depreciation; interest; and taxes (as these items are recorded on the site's income statement).

- Cash flow, which equals net income plus depreciation.

Depreciation reflects previous, rather than current, expenditures and does not actually absorb incoming revenues. Brigham and Gapenski, 1997 note that—in capital budgeting—it is critical to base decisions on cash flows or the actual dollars that flow into and out of the company during the evaluation period. The Financial Accounting Standards Board, in SFAS Nos. 105, 107 and 119 recommends the present value of future cash flows as a means of identifying market value (FASB, 1996). EPA, therefore, selected cash flow as the basis for measuring the present value of future site operations.[4]

4.2.1.3 Time Frame for Consideration

EPA uses a 16-year time period for forecasting future income to correspond to the time period used in the cost annualization model (see Appendix A). Although it might be appropriate to use the estimated actual lifetime of the equipment rather than the depreciation period, the extended lifetime results in a lower estimated annualized cost because of the greater number of years over which to spread the capital investment. EPA preferred to use the more conservative (shorter) time frame. The first year's data are not discounted, again to keep the cost annualization and forecasting projections on a consistent basis.

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[4]EPA performed a sensitivity analysis based on net income with the costs and forecasting methodology at proposal (Motwane and Kaplan, 2001). The largest effect is an increase in the number of sites presumed to fail prior to the incurrence of incremental pollution control costs. Subcategories that showed no incremental impacts from the proposed costs based on cash flow projections also showed no incremental impacts under net income projections. Subcategories that showed an impact based on cash flow, i.e., cokemaking, also showed an impact under net income projections. For cokemaking, the site projected to close as a result of the regulation under the cash flow assumption was a baseline closure under the net income assumption. A different site was projected to close under the net income assumption as a result of the rule. So although the facilities changed, the number and magnitude of the impacts remained consistent across the sensitivity analyses, particularly when all subcategory costs were aggregated for the site closure analysis.

4.2.2 Present Value of Future Earnings

4.2.2.1 Adjusting Questionnaire Data for Projections

Adjusting Earnings to an After-Tax Basis

Depending on the corporate hierarchy for the site, the earnings reported in the questionnaire may have to be adjusted for taxes. A site may fall into one of several categories:

- It is (1) part of a multi-site corporation, (2) interest and taxes are not passed back to the site, and (3) earnings are taxed at the corporate rate.
- It is (1) part of a multi-site organization, and (2) income is taxed at the rate for individuals (e.g., partnerships, sole proprietorships, etc.).
- The site is, or is part of, an S Corporation or Limited Liability Corporation.
- The site is the business entity; therefore, the complete income statement data is supplied for the site. Because net income is presented on an after-tax basis, no adjustments need to be made. These facilities have corporate hierarchy type "F" in the detailed questionnaire. For sites that received the short form, the site was presumed to be the business entity if the data for the site and company were identical.
- The site has a foreign owner. In these cases, the business entity information is not appropriate to use because GAAP may differ from country to country. These sites are treated as if they were independent companies, i.e., the site is the business entity.
- It is (1) part of a multi-site corporation, and (2) interest and taxes are passed back to the site.

Adjusting Earnings to After-Tax Cash Flow

For the first two categories (multiple facilities under the same ownership), cash flow is calculated as:

$$\text{Cash Flow} = [(\text{EBIT}) * (1 - (\text{federal} + \text{state tax rates}))] + \text{depreciation}$$

where the federal and state tax rates are dependent on corporation type and income at the business entity level, see Section A.1 for more details. That is, EPA reduces operating earnings by estimated taxes. EPA does not make a similar adjustment for interest because the respondents themselves do not allocate interest to the site.

S corporations and limited liability corporations (the third category) do not pay taxes. They distribute income to the partners and tax is paid by the partners at each partner's personal tax level. (That is, the company doesn't pay taxes, the partners pay taxes.) Therefore, no adjustment is needed.

For the fourth through sixth categories—single site businesses or sites with allocated interest and taxes, cash flow is calculated as:

Cash Flow = net income + depreciation

4.2.2.2 Forecasting Methods for Future Cash Flow

Site cash flow must be forecast over the 16-year project lifetime. All forecasting methods examined for and used in the closure analysis incorporate the following assumptions and procedures:

- No growth in real terms.
- Constant 1997 dollars. Data from 1995 and 1996 are inflated using the change in the Consumer Price Index (CEA, 1999).

The "no growth" assumption is made so that a site is not assumed to grow its way out of an economic impact associated with additional pollution control costs; essentially, sites are assumed to be running at or near capacity and significant growth is assumed to be unlikely without a major capacity addition.

Section 2.10 indicates that earnings in the steel industry sometimes show pronounced year-to-year variations as well as an underlying cyclicality, see Figure 2-10. Table 4-1 summarizes AISI data for industry cash flow from 1986 through 2000 (AISI, 2000). The cash flows are adjusted to 1997 dollars via

Table 4-1

Scaling Factors

	Cycle 1		Cycle 2	
Year	Proposal	Now	Proposal	Now
2002	0.62	-1.53	1.21	1.39
2003	-0.32	1.23	0.78	1.13
2004	-1.09	0.37	1.00	1.22
2005	1.37	1.38	0.97	0.79
2006	1.12	0.63	0.06	1.00
2007	1.21	-0.33	-1.09	1.09
2008	0.78	-1.10	1.37	0.56
2009	1.00	1.39	1.12	0.38
2010	0.97	1.13	1.21	-1.10
2011	0.06	1.22	0.78	1.39
2012	-1.51	0.79	1.00	1.13
2013	1.21	1.00	0.97	1.22
2014	0.37	1.09	0.06	0.79
2015	1.37	0.56	-1.09	1.00
2016	0.62	0.38	1.37	1.09
2017	-0.32	-1.53	1.12	0.56

Sources: AISI, 2000 and CEA, 2001

the Consumer Price Index (CPI). The last column in the table calculates the ratio of the cash flows to the 1997 value. The scaling factors are used in the forecasting model to adjust each site's earnings to the projected value.

Methods used for proposal. EPA developed three forecasting models for proposal: (1) a three-year average based on 1995-1997 survey data,[5] (2) a time-varying cash flow that adjusted 1998 and 1999 data to account for the industry downturn and followed the 1988-1999 industry pattern, and (3) a time-varying cash flow that adjusted 1998 for the industry downturn and assumed that the industry followed the 1992-1999 industry pattern (U.S. EPA, 2000a). That is, two of the three methods adjusted for the industry downturn and cyclicality.

Changes to forecasting methodology in response to comments and data submitted on the proposed regulation. EPA made several revisions in the methodology:

- EPA revised the industry scaling factors for 1998 and 1999 based on AISI data. The original values overestimated the actual downturn in the industry.
- EPA added an industry scaling factor for 2000 based on AISI data.
- EPA incorporated 1998-2000 financial data where it was submitted by the respondents. This primarily affected the merchant cokemaking sites.
- EPA added two new forecasting methods
  - a six-year average (1995-2000 data)
  - 2000 year data

As a result, four of the five forecasting methods incorporate the industry downturn.

Figure 4-3 illustrates the different forecasting methods. From left to right, the figure has three sections representing the period for the survey data (1995-1997), the rulemaking period (1998-2001), and

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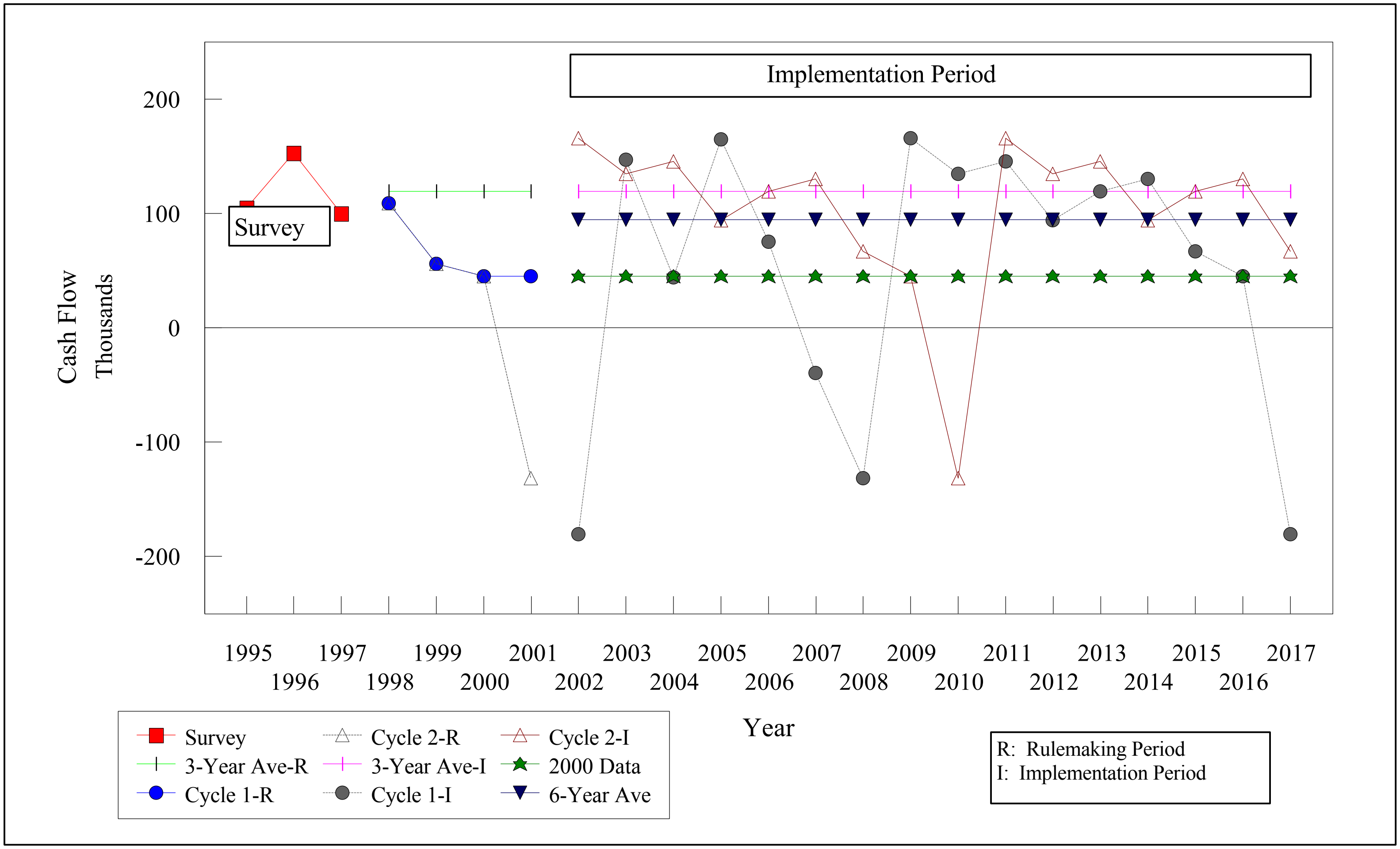
[5]EPA requested three years of data in the questionnaire to mitigate the uncertainty in the analysis resulting from a single datum point. For new or newly-acquired facilities, however, one year of data may be all that is available for analysis. For facilities with a trend in income, the most recent year may be the more conservative estimate of future cash flow. If only two years of data are available, the model calculates the average of the two values. If only 1997 data are available, that year's data are used.

Figure 4-3
Forecasting Methods



promulgation and implementation (2002 through 2017).[6] The section of data on the left-hand side of the graph shows the actual 1995-1997 cash flow from the survey data. Series labeled "R" are in the rulemaking period while those labeled "I" are in the implementation period.

The forecasting methods begin during the rulemaking period. The horizontal line with diamonds is the 3-Year Average forecast. The line continues at the same level throughout the 2002-2017 period. The cyclical forecasting methods have the same data points for 1998, 1999, and 2000 because they are based on recent industry data. The methods begin to differ in 2001. Cycle 1 (circle) assumes that 2001 looks like 2000 but begins a downturn as severe as 1986 in 2002. That is, the three-year average value is multiplied by the 1986 scaling factor in Table 4-1 for 2002. The remaining forecast is based on the 1987-2000 scaling factors with the value for 2017 repeating the start of the cycle with the 1986 scaling factor. That is, years 2002 and 2017 have the same value. Cycle 1 has the industry hitting a severe downturn when the rule goes into effect.

Cycle 2 (triangle) assumes that 2001 reflects a downturn as severe as 1992, that is, the value is the product of the three-year average and the 1992 scaling factor shown in Table 4-1. This forecasting method assumes the industry has learned from its 1989-1992 experience and will file trade cases rapidly once it determines that imports play an important role in the downturn. The 2002-2009 forecast is based on the 1993-2000 scaling factors. Because of the shorter cycle, the forecast for 2010 begins the cycle again with the 1992 scaling factor. Cycle 2 has the effect of the industry hitting an upturn when the rule is promulgated.

The forecasting methods added after proposal—the 6-Year Average and 2000 Data—are shown in Figure 4-3 by horizontal lines with inverted triangles and stars, respectively. For sites that supplied 1998-2000 data, those data are used in the forecasting methods. The combination of all five forecasting methods covers a wide range in possible future industry financial behavior.

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[6] EPA chose the 16-year period in the forecasting model marked by years 2002 through 2017 to coincide with the 16-year period used in the cost annualization model. It is unrelated to the statutory deadline for compliance.

4.2.2.3 Discount Rate

The final step in estimating each site's pre-regulatory present value is to discount the cash flow stream back to the first year in the time series. This step does not adjust the stream for inflation because the projections are in constant dollars. Thus, the discount rate used for discounting must be a real discount rate, obtained by adjusting the nominal discount rate for the expected annual rate of inflation (see Appendix A). The same site-specific real discount rate is used in both the cost annualization and closure models.

4.2.3 Projecting Site Closures As A Result Of The Rule

With five forecasting methods, there are five ways to evaluate a site's status. If a site's post-regulatory status is less than zero, the site is assigned a score of “1" for that forecasting method. A site, then, may have a score ranging from 0 to 5.

Closure is the most severe impact that can occur at the site level and represents a final, irreversible decision in the analysis. The decision to close a site is not made lightly; the business is aware of and concerned with the turmoil introduced into its workers' lives, community impacts, and how the action might be interpreted by stockholders. The business will likely investigate several business forecasts and several methods of valuing their assets. Not only all data, assumptions, and projections of future market behavior would be weighed in the corporate decision to close a site, but also the uncertainties associated with the projections. When examining the results of several analyses, the results are likely to be mixed. Some indicators may be negative while others indicate that the site can weather the current difficult situation. A decision to close a site is likely to be made only when the weight of evidence indicates that this is the appropriate path for the company to take.

EPA emulated corporate decision-making patterns when determining when a site would close. A score of 1 or 2 may result from an unusual year of data. When the score is 3, 4, or 5, however, EPA deemed that weight of the evidence now indicates poor financial health. EPA believes that this scoring approach represents a reasonable and conservative method for projecting closures.

4.2.3.1 Incorporation of Proposed MACT Costs in Pre-Regulatory Analysis

EPA responded to comments on the proposed rule by incorporating the costs for the proposed MACT requirements on pushing, quenching, and battery stacks for coke ovens (U.S. EPA, 2000b and FR, 2001a) and for integrated steel operations (U.S. EPA, 2000c and FR, 2001b).

4.2.3.2 Pre-Regulatory Conditions

The closure analysis begins with an evaluation of the pre-regulatory status of each site. Several conditions may lead to a site having a score of 3, 4, or 5 under pre-regulatory conditions:

- The company does not record sufficient information at the site-level for the closure analysis to be performed.
- The company does not assign costs and revenues that reflect the true financial health of the site. Two important examples are cost centers and captive sites, which exist primarily to serve other facilities under the same ownership. Captive sites may show revenues, but the revenues are set approximately equal to the costs of the operation. (Cost centers have no revenues assigned to them).
- The site appears to be in financial trouble prior to the implementation of the rule.

Under the first two conditions, the impacts analysis defaults to the company level because that is the decision-making level. For example, earnings data are held at the company level, not the site level or the company has intentionally established facilities that will not show a profit but exist to serve the larger organization. In either case, EPA does not have sufficient information to evaluate impacts at the site level *as a result of the rule*.

The third condition identifies a site with complete site-level financial information and no confounding factors (i.e., it is not a captive site, a start-up site, or a site with joint or foreign owners) to obscure the financial condition of the site. If the site is unprofitable prior to the regulation, the company may decide to close the site. This is likely to occur before the implementation of the rule to avoid additional investments in an unprofitable site. The projected closure of a site that is unprofitable prior to a regulatory action should not be attributed to the regulation.

4.2.3.3 Estimation of Site Closures as a Result of the Rule

EPA changed its decision criteria from proposal in response to comments on the fragile health of the iron and steel industry at this time. In the economic analyses for promulgation, EPA considered **any** change from the baseline score as an impact of the regulation. For example, a change in score from 0 to 1 is considered an impact in the economic analyses presented in Chapter 6. Formerly, at proposal, a change in score from 0 to 1 would not have been considered an impact.

4.2.3.4 Direct Impacts

Closure represents a final, irreversible decision in the analysis.[7] EPA estimates direct impacts from site closures as the loss of all employment, production, exports, and revenue associated with the site. This is an upper bound analysis, i.e., illustrating the worst effects because it does not account for other sites increasing production or hiring workers in response to the closure of the first site.[8] The losses are aggregated over all sites to estimate the national direct effect of the regulation.

4.3 COMMUNITY AND NATIONAL IMPACTS

4.3.1 National Direct and Indirect Impacts

Impacts on the steel industry are known as direct effects, impacts that continue to resonate through the economy are known as indirect effects (effects on input industries), and effects on consumer demand are known as induced effects. The U.S. Department of Commerce, Bureau of Economic Analysis (BEA) tracks these effects both nationally and regionally in massive "input-output" tables, published as the Regional Input-Output Model (RIMS II) multipliers. For every dollar in a "spending" industry, these

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[7] Sites that are sold because a new owner presumably can generate a profit when the current owner cannot are considered *transfers*. Transfers are not assumed to incur closure-related impacts.

[8] The market model, however, accounts for this effect.

tables identify the portion spent in contributing or vendor industries. For this analysis, EPA calculates direct and indirect impacts with the national-level final-demand multipliers for

- output (2.993 dollars per dollar) and
- employment (24.131 full-time equivalents per $1 million in output in 1992 dollars[9])

for BEA industry 37.0101 blast furnaces and steel mills (DOC, 1996).

4.3.2 Community Impacts

As mentioned in Section 4.2.2, all employment is considered lost if a site is projected to close. EPA evaluates the community impacts of site closure by examining the increase in 1997 unemployment rate for the county or metropolitan statistical area in which the site is located (Le Vasseur, 1998 and BLS 2000).

4.4 CORPORATE FINANCIAL DISTRESS ANALYSIS

The closure analysis focuses on the question whether it makes financial sense to upgrade a given site. It does not examine whether the company can raise the capital to make that investment. The corporate financial distress analysis examines whether a company can afford the aggregate costs of upgrading all of its sites.[10] EPA selected a weighted average of financial ratios to examine the impacts of increased pollution control on companies. Many banks use financial ratio analysis to assess the credit worthiness of a potential borrower. If the incurrence of regulatory costs causes a company's financial

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[9]Employment multipliers are based on 1992 data, hence the loss in output needs to be in 1992 dollars.

[10]For a single-site company, the results of the closure analysis take precedence. That is, if the site is determined likely to bear an impact based on the comparison of profitability before and after the regulation, the company is not included in the corporate distress analysis.

ratios to move into an unfavorable range, the company will find it more difficult to borrow money. Under these conditions, EPA considers the company to incur financial distress.

Financial ratios are calculated at the business entity or corporate parent level because:

- Accounting procedures maintain complete financial statements (balance sheet and income statement) at the business entity or corporate level, but not necessarily at the site level. The survey data indicate that many companies do not keep complete financial statements at the site level.

- Significant financial decisions, such as expansion of a site's capacity, are typically made or approved at the corporate level.

- The business entity (or corporate parent) is the legal entity responsible for repayment of a loan. The lending institution evaluates the credit worthiness of the business entity, not the site.

The analysis includes both public and private entities. EPA's survey of the industry is the only source of financial data for private companies (U.S. EPA, 1998). Section 4.4.1 describes the Altman Z'-score, a weighted average of financial ratios used to assess financial distress. Section 4.4.2 summarizes the preparation of the survey data for the analysis. Section 4.4.3 reports the pre-regulatory status of the industry.

4.4.1 Altman Z'-Score

EPA performed a literature search to review bankruptcy prediction literature from 1990 to 1998 (Kaplan, 1999). Although new approaches have been developed (such as, neural networks, logit models, and multiple discriminant analyses), there is no one method that is clearly superior and no consensus on what is the best approach. EPA determined that—for the purposes of selecting a methodologically sound, reproducible, and defensible approach—a multiple discriminant analysis of financial ratios was appropriate.

EPA selected a multidiscriminant function (e.g., a weighted-average) of financial ratios, called the Altman Z-score, to characterize the baseline and post-regulation financial conditions of potentially affected firms. The Altman Z-score is a well accepted standard technique of financial analysis with nearly two decades of use (see Brealy and Meyers, 1996, and Brigham and Gapenski, 1997). The Z-score has advantages over consideration of an individual ratio or a collection of individual financial ratios:

- It is a simultaneous consideration of liquidity, leverage, profitability, and asset management. It addresses the problem of how to interpret the data when some financial ratios look "good" while other ratios look "bad."

- There are defined threshold or cut-off values for classifying firms in good, indeterminate, and poor financial health. "Rules of thumb" are available for some financial ratios, such as current ratio and times interest earned, but these frequently vary with the industry (U. S. EPA, 1995).

Altman (1993) developed several variations on the multidiscriminant function. EPA selected the Z'-score because it was developed to evaluate public and private manufacturing firms. The model is:

$$Z' = 0.717X_1 + 0.847X_2 + 3.107X_3 + 0.420X_4 + 0.998X_5$$

where the pre-compliance components are:

Z'	=	overall index
X_1	=	working capital/total assets
X_2	=	retained earnings/total assets
X_3	=	earnings before interest and taxes (EBIT)/total assets
X_4	=	book value of equity (or net worth)/total debt
X_5	=	sales/total assets

The iron and steel survey requested each piece of information for the analysis. (Working capital is equal to current assets less current liabilities.) Book value of equity is also called net worth (i.e., total assets minus total debt). Total debt is the sum of current and non-current liabilities.

Taken individually, each of the ratios given above (X_1 through X_5) is higher for firms in good financial condition and lower for firms in poor financial condition. Consequently, the greater a firm's distress potential, the lower its discriminant score. An Altman Z'-score below 1.23 indicates that distress is likely; a score above 2.9 indicates that distress is unlikely. Z'-scores between 1.23 and 2.9 are indeterminate. In order to focus on marginal firms that are most likely to be affected by the regulation, EPA has chosen to consider an Altman Z'-score of **1.21** and below to indicate that distress is likely.[11]

EPA estimates financial distress based on changes in the Altman Z'-score as a result of pollution control costs. Capital costs are those developed by the engineering staff for use in the cost annualization model. The annualized pollution control costs for each option were calculated from the engineering estimates of capital and operating and maintenance costs in the cost annualization model (see Appendix A). The estimates of post-compliance scores are calculated as follows:

Z'	=	overall index
X_1	=	working capital/(total assets + capital costs)
X_2	=	retained earnings/(total assets + capital costs)
X_3	=	(EBIT - pre-tax annualized compliance costs)/(total assets + capital costs)
X_4	=	book value of equity (or net worth)/(total debt + capital costs)
X_5	=	sales/(total assets + capital costs)[12]

[11]This is consistent with Altman's observation that the average U.S. firm has a lower Z-score today than in the past and he has chosen to adjust cutoff scores or build new models rather than revising the original weightings (Altman, 1993, pp. 179-180). The reader should be aware that Altman developed several Z-score models, i.e., Z, Z', and Z". Each model has a different set of variables, coefficients, and distress thresholds. The Z-score model is for publicly held firms and uses a threshold value of 1.81. The iron and steel analysis uses the Z'-score because it examines a mix of public and private firms.

[12]Although the annualized compliance cost incorporates capital expenditures, one-time non-capital expenditures, and yearly operations and maintenance costs, EPA performed a sensitivity analysis to evaluate whether the one-time costs provided an extra shock to the company. In the sensitivity analysis, the post-compliance X_3 parameter is calculated as (EBIT - pre-tax annualized compliance costs - *one-time costs*)/(total assets + capital costs). The change made no difference to the post-regulatory status of any company.

4.4.2 Survey Data Preparation

4.4.2.1 Baseline Year

The most recent year for which survey collected data is 1997. This is the baseline year for the economic analysis. The iron and steel industry is cyclical. Therefore the pre-rulemaking condition of the industry varies year-by-year. However, the intent of the economic analysis is to have a "snapshot in time" of the industry and to examine the changes wrought by the imposition of additional pollution control costs, rather than focus on the baseline value itself. The use of 1997 as the baseline year for the analysis does not mean that EPA ignores the events of 1998 and 1999 (see Section 2); its focus, rather, is on the change caused by the incremental costs.[13]

4.4.2.2 Ownership Changes from 1997

EPA tracks changes in the industry since the survey. Site ownership changes since 1997 are reflected in the aggregate costs for the new owner. That is, if a business entity had three iron and steel sites in 1997 but purchased two more since (and these sites were surveyed), the aggregate costs for the business entity reflects all five sites.

4.4.2.3 Determination of Which Level in the Corporate Hierarchy for Data to Use in Analysis

Corporate ownership in the iron and steel industry is frequently complex, reflecting mergers and acquisitions that occurred over the years. EPA examined the survey data site-by-site to ensure that all sites that could ultimately be tied to the same corporate parent were analyzed with the same data whether it might have been entered as the business entity or the corporate parent. For all joint entities, the corporate financial analysis was performed with Section 2 (site/joint entity) survey data rather than any of the owning entities. Section 3 survey data were used if they represented aggregate U.S. holdings of a foreign business

[13]EPA explicitly addresses the 1998 and 1999 industry downturn in the forecasting methods for the site financial analysis, see Section 4.3.

entity. EPA did not use financial information for foreign firms due to differences in generally accepted accounting principals among countries.

4.4.2.4 Aggregation Of Site-level Regulatory Cost Data

EPA estimated costs on a site basis. EPA then aggregated site-level regulatory costs to the business entity level in order to assess the impact of the total costs incurred by the business entity.

4.4.3 Evaluation of Pre-regulatory Altman Z' Scores

EPA calculated the pre-regulatory condition of the industry in order to evaluate the post-regulatory impacts on an incremental basis. As with the site closure analysis, EPA included the costs of the proposed MACT rules on coke ovens and integrated steelmaking operations prior to evaluating the impacts of increased water pollution control costs. Of the 115 companies in the initial Altman Z' analysis:

- 27 fall into the "distress likely" zone
- 56 are in the indeterminant zone
- 32 are in the "distress unlikely" zone.

Of the 27 companies in the "financial distress likely" zone,

- 2 have ceased operations
- 7 took Chapter 11 since 1997 (i.e., declared bankruptcy). One was in Chapter 11 before 1997.
- 4 changed ownership.
- 5 had just begun operations in 1997. These show all the startup costs, little revenues, and no retained earnings.

- # 6 are non-startup joint entities. The Altman Z' calculation is based on the joint entity's financial statements rather than those of any of the businesses that share ownership of the site.

- # 11 are owned by a foreign company. Because generally accepted accounting principles (GAAP) differ from country to country, the Altman Z' was calculated on the site financial data rather than the owning company. It appears that some distortion may still be present in the data.

Some companies may fall into two or more categories. The financial statements of other companies in the "financial distress likely" zone frequently indicate various stages of financial distress such as shareholder deficits, inability to pay dividends, certain (unspecified) operating problems, and not being compliant with debt covenants. In other words, for a multitude of reasons, the Altman Z'-score identifies a reasonable set of companies that might be considered distressed.

4.4.4 Implications of a Z'-score Below The Cut-off

What does it mean for a company to have its Z'-score fall below the cut-off for "distress likely"? It should be noted that Altman used the phrase "bankruptcy likely" rather than "distress." First, this does not mean that a company will immediately declare bankruptcy once its score falls into that danger zone. It is a warning flag. A company has the opportunity to change its behavior during this warning period to avoid the projected bankruptcy. The Chrysler Corporation is an example; Altman, 1993 cites other examples.

Second, taking Chapter 11 (bankruptcy) is not the same as taking Chapter 7 (liquidation). A company that takes Chapter 11 is protected from its creditors for a period of time while it reorganizes itself. A company can continue to operate while it is in Chapter 11. Geneva Steel filed for Chapter 11 on February 1, 1999 but continued to operate through the next year (Geneva Steel, 2000). Shenango Coke went into Chapter 11 in 1992. A company has the chance to emerge from Chapter 11. In contrast, a firm is liquidated when there is no hope for rehabilitation. Altman notes, "Economically, liquidation is justified when the value of the assets sold individually exceeds the capitalized value of the assets in the marketplace." (Altman, 1993, p. 33).

Third, other forms of response are possible and seen in the initial evaluation of the steel industry. Shedding non-productive assets, merging with another company, or being purchased by another company are all possible responses to financial distress.

What this means for the economic analysis is that:

- a company that moves into the distress likely category as a result of added pollution control costs is considered to be distressed as a result of the regulation. It does not mean that EPA expects the company to liquidate immediately upon promulgation. The company, however, will have to change the way it operates to respond to the regulation and remain out of bankruptcy.

- a company in the distress likely category before the rulemaking cannot be evaluated for a change in status. It does not mean that EPA expects the company to liquidate in the very near future.

4.5 MARKET MODEL

With the market model, the analysis moves to the larger-scale industry-wide impacts. When EPA evaluates site closure impacts as the loss of all production at the site, this is a possible overestimate because other sites could step up their production in response. The output from the market model, however, incorporates such effects. In contrast, while the market model developed for the steel industry may estimate the reduction in production due to higher costs, it does not specify at which sites the reductions might occur. So the results from the various models are related but not necessarily identical.

A market model is a set of equations designed to represent the behavior between steel producers and steel consumers. Increased pollution control generally adds to the cost of production.[14] Steel producers then ask for a higher price to cover their higher costs. Steel consumers may respond to higher prices by buying less domestic steel and/or increasing imports. If consumers buy less steel, then producers

[14] However, this is not always the case. See Table 5-4. The regulatory options for stainless steel finishing operations that include acid recovery lead to annual savings in material costs.

may cut back production, thereby leading to job losses. A purpose of a market model is to estimate the supply and demand for steel in order to quantify these regulatory impacts.

EPA's approach to modeling the steel industry is to specify a cost function that can be estimated econometrically and derive the market supply relationship from the cost function (Applebaum, 1982; Considine, 1991; Kwack, 1991). EPA specified the cost function with the following characteristics:

- translog function
- one good
- two production factors (capital and materials)
- subject to technological change (continuous casting)

The steel market supply relationship is derived from the translog cost function and equilibrium conditions for profit maximization. In general, a firm maximizes profits when the cost to produce an additional unit (i.e., marginal cost) equals the revenue earned from selling that unit (i.e., marginal revenue). Marginal cost is derived by differentiating the cost function with respect to output. The marginal revenue, however, will vary with the competitiveness of the market in which the firm sells. The formula expressing marginal cost incorporates a parameter that measures the degree of market competitiveness.

The U. S. demand for steel is modeled as the sum of U.S. demand for domestic steel plus imports (i.e., U.S. demand for imported steel). It is calculated as a function of the prices of domestic steel, imported steel, and steel substitutes and measures of activity in major steel-using industries. Conversely, the total demand for U.S. steel is modeled as the sum of U.S. demand for domestic steel plus exports (i.e., foreign demand for U.S. steel). For the purpose of this study, EPA aggregated all other countries into a single entity that trades steel with the U.S. EPA used the relations between key elasticities in the Armington specification trade model (Armington, 1969a; Armington, 1969b) to estimate the elasticity of demand for imported steel with respect to a change in the price of U.S. steel and the elasticity of demand from the rest of the world for U.S. steel with respect a change in the price of U.S. steel.

The steel market model consists of five equations:

- # a translog cost function
- # two conditional factor demand functions (capital and materials) derived from the cost function,
- # a supply relationship, and
- # a domestic demand function.

EPA estimated all equations using nonlinear three-stage least-squares (NL3SLS). NL3SLS is a "full information" econometric technique; all equations are estimated simultaneously, which allows the cross-equation restrictions (e.g., between the cost function and the conditional factor demand equations) to improve estimates of the parameters.[15] EPA used 20 years of Census and industry data from 1977 to 1997 as its sample time frame. The model estimates the supply shift, and the resulting changes in: domestic price, domestic consumption, export demand, and import supply. A detailed discussion of the theoretical foundation for the model, data sources, and indices is located in the rulemaking record.

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[15] A "limited information" technique such as two stage least squares estimates each equation separately; the "information" in the conditional factor demand equations, for example, has no effect on the parameter estimates for the cost function.

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CHAPTER 5

REGULATORY OPTIONS: DESCRIPTIONS, COSTS, AND CONVENTIONAL POLLUTANT REMOVALS

Table 5-1 summarizes the subcategories as promulgated in 1982, the re-subcategorization as proposed in 2000, and the promulgated subcategories. For continuity with the information presented at proposal, the costs are presented for 2000 subcategories. That is, when the text refers to "ironmaking," it refers to both blast furnace and sintering operations. The term "sinter" refers to the subset of facilities with sintering operations. Section 5.1 describes the technological bases for the proposed standards.[1] Section 5.2 identifies the cost associated with each option while Section 5.3 summarizes associated conventional pollutant removals and cost per pound removed. A site may have operations in more than one subcategory; combined costs are discussed in Section 5.4 below. All costs discussed in this chapter are in 1997 dollars. Cost-effectiveness results are presented in Appendix C.

5.1 DESCRIPTION

Table 5-2 presents the regulatory options for each subcategory: Cokemaking, Ironmaking, Integrated Steelmaking, Integrated and Stand-Alone Hot-Forming, Non-Integrated Steelmaking and Hot-Forming, Steel Finishing, and Other Operations. The final column describes the treatment components for each option. More information on the regulatory options is located in the Development Document (U.S. EPA, 2002).

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[1]EPA proposed no modifications from existing BAT for the stainless steel segment of the Integrated Steelmaking and Stand-alone Hot Forming subcategory. EPA proposed no modifications from existing PSES for the Integrated Steelmaking, Integrated Steelmaking and Stand-alone Hot Forming (all segments), Nonintegrated Steelmaking (carbon and alloy steel segment), Finishing (all segments). EPA did not propose PSES for Other Operations (DRI and forging).

Table 5-1

Iron and Steel Manufacturing Subcategories

<table>
<tr><th>1982</th><th colspan="2">Proposed 2000</th><th>Final 2002</th></tr>
<tr><td>A. Cokemaking</td><td colspan="2">A. Cokemaking</td><td>A. Cokemaking</td></tr>
<tr><td>B. Sintering</td><td colspan="2" rowspan="2">B. Ironmaking</td><td>B. Sintering</td></tr>
<tr><td>C. Ironmaking</td><td>C. Ironmaking</td></tr>
<tr><td>D. Steelmaking</td><td rowspan="3">C. Integrated Steelmaking</td><td rowspan="4">D. Non-Integrated Steelmaking and Hot Forming</td><td>D. Steelmaking</td></tr>
<tr><td>E. Vacuum Degassing</td><td>E. Vacuum Degassing</td></tr>
<tr><td>F. Continuous Casting</td><td>F. Continuous Casting</td></tr>
<tr><td>G. Hot Forming</td><td>E. Integrated and Stand-Alone Hot Forming</td><td>G. Hot Forming</td></tr>
<tr><td>H. Salt Bath Descaling</td><td colspan="2" rowspan="5">F. Steel Finishing</td><td>H. Salt Bath Descaling</td></tr>
<tr><td>I. Acid Pickling</td><td>I. Acid Pickling</td></tr>
<tr><td>J. Cold Forming</td><td>J. Cold Forming</td></tr>
<tr><td>K. Alkaline Cleaning</td><td>K. Alkaline Cleaning</td></tr>
<tr><td>L. Hot Coating</td><td>L. Hot Coating</td></tr>
<tr><td></td><td colspan="2">G. Other Operations</td><td>M. Other Operations</td></tr>
</table>

Table 5-2

Description of Regulatory Options by Subcategory

Subcategory	Discharge Status	Regulatory Option	Description of Regulatory Option
Cokemaking	Direct	BAT 1	# Tar/oil removal, ammonia stripping, and biological treatment with clarification # Liquid/solid separation and heat exchanger
		BAT 3	# BAT 1 + break-point chlorination
	Indirect	PSES 1	# Tar/oil removal, equalization, and ammonia stripping
		PSES 3	# PSES 1 + biological treatment with clarification
Ironmaking (Sintering and Blast Furnace)	Direct	BAT 1	# Solids removal, high rate recycle, metals precipitation, alkaline chlorination, and mixed-media filtration for blowdown wastewater # Cooling tower (blast furnace operations only)
	Indirect	PSES 1	# Same as BAT 1
Integrated Steelmaking	Direct	BAT 1	# Solids removal and high rate recycle # Cooling tower(s) # Metals precipitation for blowdown wastewater
Integrated and Stand-Alone Hot Forming	Direct	BAT 1 (Carbon)	# Scale pit with oil skimming, roughing clarifier, mixed-media filtration, cooling tower, and high rate recycle
Non-Integrated Steelmaking and Hot-Forming	Direct	BAT 1 (Carbon)	# Solids removal, sludge dewatering, mixed-media filtration, cooling tower, and high rate recycle
		BAT 1 (Stainless)	# Solids removal, sludge dewatering, mixed-media filtration, cooling tower, and high rate recycle
	Indirect	PSES 1 (Stainless)	# Same as BAT 1
Steel Finishing	Direct	BAT 1 (Carbon)	# Diversion tank, oil removal, hexavalent chrome reduction, equalization, metals precipitation, sedimentation, and sludge dewatering
		BAT 1 (Stainless)	# Diversion tank, oil removal, hexavalent chrome reduction, equalization, metals precipitation, sedimentation and sludge dewatering, and acid purification
Other Operations	Direct	BAT 1 (DRI)	# Solids removal, clarifier, sludge dewatering, and high rate recycle # Filtration for blowdown wastewater
		BAT 1 (Forging)	# High rate recycle, oil/water separator for blowdown wastewater, and mixed-media filtration

The **cokemaking** subcategory has two segments—one where the cokemaking by-products are recovered and the second where they are not. The cokemaking subcategory does not have subsegments. EPA considered two regulatory options for direct dischargers and two options for indirect dischargers. BAT 1 includes tar removal, heat exchanger, ammonia stripping, biological treatment, and liquid and solid separation. BAT 3 adds break-point chlorination to BAT 1. PSES 1 utilizes tar removal, equalization, and ammonia stripping. PSES 3 adds biological treatment to PSES 1; that is, it is comparable to BAT 1.

EPA considered one regulatory option each for direct and indirect dischargers in the **ironmaking** subcategory. The treatment unit is the components listed in the first bullet while the second bullet describes the cooling tower applicable only to blast furnace operations. EPA also considered regulating **sintering** operations, a subset of the ironmaking subcategory.

EPA considered one regulatory option for direct dischargers in the **integrated steelmaking** subcategory. Cooling towers are necessary only if a site employs vacuum degassing or continuous casting.

Hot forming operations are found at both integrated sites and stand-alone sites. EPA proposed modifcations only for direct dischargers with carbon and alloy steel. The regulatory option includes a scale pit with oil removal, a roughing clarifier with oil removal, mixed-media filtration, cooling, and high rate recycle.

Non-integrated steelmaking uses an electric arc furnace (EAF) rather than a basic oxygen furnace. The technologies do not vary by whether the sites process carbon steel or stainless steels, but the costs and pollutant removals do vary.

Both carbon and stainless steel options in the **finishing** subcategory include a diversion tank, oil removal, hexavalent chrome reduction, equalization, metals precipitation, and sedimentation and sludge dewatering. The stainless steel segment has an added step of acid purification.

The **other** operations subcategory, is further subdivided into DRI operations and forging operations. (All briquetting operations are zero discharge.) For DRI operations, BAT 1 require solids removal, a clarifier, high rate recycle, and blowdown treatment. For forging operations, BAT 1 requires high rate recycle, an oil-water separator for blowdown wastewater, and mixed-media filtration.

5.2 SUBCATEGORY COSTS

Table 5-3 summarizes the capital, annual operating and maintenance (O&M), and one-time non-equipment costs for each of the regulatory options considered[2]. **Cokemaking** costs are presented in Table 5-3 for both direct and indirect dischargers. For direct dischargers, the capital cost range is $24 million to $54 million while the post-tax annualized cost ranges from $6.1 million to $9.6 million. For indirect dischargers, the capital costs range from $6 million to $23 million while the post-tax annualized costs range from nearly $2 million to $6 million. EPA proposed BAT 3 for cokemaking but subsequently found it not to be economically achieveable.

Ironmaking costs for direct and indirect dischargers are $50 million in capital costs while the post-tax annualized cost is $9.6 million. **Sintering** costs, however, total $11 million in capital cost and $1.8 million in post-tax annualized costs.

Integrated steelmaking costs for direct and indirect dischargers are $43 million in capital costs while the post-tax annualized cost is $9.5 million. For these subcategories, costs are presented on a combined basis because there are three or fewer indirect dischargers in each subcategory.

Integrated and stand-alone hot forming costs are the largest of any subcategory examined. The capital costs for direct dischargers are $137 million and the post-tax annualized costs are $25.2 million.

Non-integrated steelmaking and hot forming costs differ by whether the site processes carbon or stainless steel. For carbon steel processors who are direct dischargers, the capital costs for BAT Option 1 are $28.2 million while the post-tax annualized cost is $4.6 million. For direct discharging stainless steel processors, the capital costs for BAT Option 1 are $4 million while the post-tax annualized cost is $0.5 million. For indirect dischargers, the post-tax annualized cost for sites with stainless steel operations is $0.2 million.

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[2]Consultant mill services to conduct an evaluation of the water management practices and operations is an example of a one-time non-equipment cost.

Table 5-3

Regulatory Options Costs by Subcategory
(in Millions of $1997)

Subcategory	Segment	Regulatory Option	Capital Costs	O&M Costs	One-Time Non-Equipment Costs	Post-Tax Annualized Costs	Pre-Tax Annualized Costs
Cokemaking		BAT 1	$24.18	$4.18	$0.27	$6.09	$6.49
		BAT 3	$54.34	$5.45	$0.27	$9.60	$10.60
		PSES 1	$6.14	$1.46	$0.09	$1.82	$1.93
		PSES 3	$23.44	$5.08	$0.27	$6.05	$7.07
Ironmaking	Sinter and Blast Furnace	BAT 1 and PSES 1	$49.97	$7.43	$0.30	$9.61	$12.59
	Sinter	BAT 1	$11.05	$1.30	$0.00	$1.75	$2.57
Integrated Steelmaking		BAT 1 and PSES 1	$43.02	$8.29	$0.25	$9.51	$12.86
Integrated and Stand-Alone Hot-Forming	Carbon	BAT 1	$137.19	$19.09	$0.23	$25.24	$33.77
Non-Integrated Steelmaking and Hot-Forming	Carbon	BAT 1	$28.17	$3.36	$1.65	$4.64	$6.03
	Stainless	BAT 1	$4.00	$0.48	$0.10	$0.49	$0.78
	Stainless	PSES 1	$1.06	$0.15	$0.10	$0.16	$0.25
Steel Finishing	Carbon	BAT 1	$21.25	$4.81	$33.58	$7.89	$10.18
	Stainless	BAT 1	$5.78	$1.58	$35.47	$3.24	$4.95

Steel finishing is the second subcategory where costs differ according to the type of steel processed. For direct dischargers, the capital costs are $21 million for carbon steel sites and $5.8 million for stainless steel sites. The post-tax annualized costs are $7.9 million for carbon steel sites. The post-tax annualized costs are $3.2 million for stainless steel sites.

The **other** subcategory consists of DRI, forging, and briquetting operations. No comments were received on the proposed options for Other operations. No costs are shown in Table 5-3 for two reasons. First, none of the sites with briquetting operations discharge process wastewater. Second, for DRI and forging, the costs for wastewater pollution control are BPT costs. Costs are presented on a combined basis due to the small number of sites with these operations. Capital costs are less than $0.2 million; post-tax annualized costs are less than $0.05 million.

5.3 COST REASONABLENESS

EPA is evaluating technology options for the DRI and forging segments of the Other Operations Subcategory for the control of only conventional parameters at BPT. CWA Section 304(b)(1)(B) requires a cost-reasonableness assessment for BPT limitations. In determining BPT limitations, EPA must consider the total cost of treatment technologies in relation to the effluent reduction benefits achieved by such technology. This inquiry does not limit EPA's broad discretion to adopt BPT limitations that are achievable with available technology unless the required additional reductions are wholly out of proportion to the costs of achieving such marginal reduction.

The cost-reasonableness ratio is average cost per pound of pollutant removed by a BPT regulatory option. The cost component is measured as pre-tax total annualized costs. In this case, the pollutants removed are conventional pollutants although in some cases, removals may include priority and nonconventional pollutants. For the DRI segment, the evaluated BPT option 1 removes approximately 1,400 pounds of conventional pollutants with a cost-reasonableness ratio of $3, see Table 5-4. For the forging segment, the evaluated BPT option 1 removes approximately 3,500 pounds of conventional pollutants with a cost-reasonableness ratio of $9. EPA considers the cost-reasonableness ratio to be acceptable and the proposed option to be cost-reasonable in both segments.

Table 5-4
Cost Reasonableness Ratio

Subcategory	Segment	Selected Option	Removal of Conventional Pollutants (lbs.)	Pre-tax Annualized Cost (Millions)	Cost Per Pound of Conventional Pollutant Removed
Other	DRI	1	1,386	$0.005	$3.3
Other	Forging	1	3,561	$0.03	$9.4

5.4 COST COMBINATIONS

EPA examined three cost combinations to evaluate the impact of the combined cost of all operations at a site, see Table 5-5. Combinations A and B correspond to the co-proposed options. Combination C corresponds to the promulgated rule, i.e., effluent limitations guidelines and standards for cokemaking, sintering, and other operations. The pre-tax annualized cost for Combination C is $11 million in 1997 dollars and $12 million in 2001 dollars, see Table 5-6. This is well below the $100 million criterion for considering the iron and steel effluent guideline a major rule under Executive Order 12866.

5.5 REFERENCES

U.S. EPA. 2002. U.S. Environmental Protection Agency. Development document for the final effluent limitations guidelines and standards for the iron and steel manufacturing point source category. Washington, DC. EPA-821-R-02-004.

Table 5-5
Cost Combinations

Subcategory	Discharge	Cost Combinations		
		A Co-proposed	B Co-proposed	C Promulgated
Cokemaking	BAT	1	1	1
	PSES	1	3	1
Ironmaking	BAT	iron	iron	sinter
	PSES	1	1	no regulation
Integrated Steelmaking	BAT	1	1	no regulation
Non-integrated Steelmaking (Carbon)	BAT	1	1	no regulation
Hotforming (Carbon)	BAT	1	1	no regulation
DRI	BPT	1	1	1
Forging	BPT	1	1	1

Notes:
1. Options for Finishing, Non-integrated Steelmaking (stainless) and Integrated Steelmaking and Hotforming Operations (stainless) categories were included at proposal but not for promulgation for technical reasons.
2. The term “iron” means ironmaking and sintering costs. “Sinter” means that limitations are considered for sintering operations segment but not the blast furnace segment.

Table 5-6

Industry Costs for Promulgated Rule (in Millions)

	Promulgated Rule	
	$1997	**$2001**
Capital Costs	$41.5	$45.2
Operating and Maintenance Costs	$7.0	$7.6
One-Time Non-Equipment Costs	$0.4	$0.5
Post-Tax Annualized Costs	$9.7	$10.6
Pre-Tax Annualized Costs	$11.0	$12.0

CHAPTER 6

ECONOMIC IMPACT RESULTS

Chapter 6 describes the economic effects resulting from the costs for implementing the selected model technologies that form the basis for the final iron and steel industry rule. The impacts are estimated with the models discussed in Chapter 4 and the costs presented in Chapter 5. Section 6.1 reports the estimated impacts from the final BPT, BAT, and PSES costs for existing sources. The impacts are examined from the smallest scale (site closure by subcategory costs) to industry-wide impacts (market and trade effects). EPA reports the results of the subcategory (Section 6.1.1), site (Section 6.1.2), and company (Section 6.1.3) analyses for the selected options and for other options considered but not selected by EPA. For the market (Section 6.1.4), direct and community (Section 6.1.5), and national (Section 6.1.6) analyses, EPA presents the finding for the promulgated rule. EPA reports its findings for NSPS and PSNS for new sources in Section 6.2.

6.1 BEST AVAILABLE TECHNOLOGY/PRETREATMENT STANDARDS FOR EXISTING SOURCES (BAT AND PSES)

6.1.1 Subcategory Costs and Projected Site Closures

6.1.1.1 Selected Options

EPA selected Cokemaking BAT 1, Cokemaking PSES 1, Sintering, and Other for promulgation. EPA examined whether the cost of upgrading pollution control in any subcategory was sufficient to result in site closure[1]. **No** closures are projected for any of the promulgated options.

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[1]The site closure methodology is presented in Section 4.2. The methodology has been revised in response to comments and data submitted on the proposed options. For a site to be considered closed rather than upgraded as a result of the regulation, its projected present value of future cash flow is neutral or positive prior to regulatory costs and negative after inclusion of regulatory costs. Section 4.2.1.1 explains why EPA did not include an estimate of salvage value in the calculation.

6.1.1.2 Other Options Considered

EPA examined additional options for the subcategories for which it promulgated regulations as well as options for subcategories for which the Agency decided not promulgate revised effluent limitations guidelines (see Table 5-2). The subcategory costs, in isolation, are sufficient to project closure for **six** sites— two in cokemaking BAT 3, two in cokemaking PSES 3, one in ironmaking BAT, and one in integrated and stand-alone hot-forming (carbon) BAT. Due to the small number of sites, the results are presented in aggregated form to protect confidentiality of the data. The projected closures represent up to 4500 job losses. For reasons of confidentiality, no details are presented on the loss of production, exports, and revenues.

6.1.2 Aggregated Subcategory Costs and Projected Site Closures

A site may have multiple operations—e.g., cokemaking, ironmaking, steelmaking, hot-forming, and finishing—with regulatory costs associated with each option. EPA examined cost combinations corresponding to the proposed and final rules, see Table 5-5.

6.1.2.1 Selected Options

EPA examined whether the cost of upgrading pollution control for all selected operations at a site was sufficient to result in site closure. **No** closures are projected for Cost Combination C from Table 5-5, the selected options.

6.1.2.2 Other Options Considered

Cost Combination A results in two projected closures. Cost combination B results in four projected site closures. The four closures results in an estimated employment loss of almost 4,000 jobs. For reasons of confidentiality, no details are presented on the loss in production, exports, and revenues.

6.1.3 Corporate Financial Distress

The level above the site is the company that owns one or more iron and steel sites. The corporate financial distress analysis identifies situations where it might make financial sense to upgrade each individual site but the company cannot bear the combined costs of upgrading all of its sites. As mentioned in Section 4.4, taking Chapter 11 (bankruptcy) is not the same as taking Chapter 7 (liquidation). EPA does not expect a company projected to move into financial distress to liquidate immediately upon promulgation. The company, however, will have to change the way it operates to respond to the regulation and remain out of bankruptcy. An analogy might be that the estimated costs move a sickly patient into intensive care. The patient may or may not return to health but much effort will be spent in the attempt.

6.1.3.1 Selected Options

No company moves into financial distress as a result of the final rule.

6.1.3.2 Options Considered

One or more large companies move into the distressed category as a result of the added pollution control with both cost combinations A and B. These companies report a total employment in excess of 14,000 people. The analysis incorporates both public and private entities; hence the analysis is based on 1997, the most recent supplied in the EPA survey. [2]

[2]Updating the corporate financial distress analysis to 2000 or 2001 would result in limiting the analysis to public companies. Private steel companies form a significant portion of the industry and EPA wanted to evaluate impacts on this group.

6.1.4 Market and Trade Impacts

Table 6-1 summarizes the market impacts for the promulgated effluent limitations guidelines. The first row lists the pre-tax annualized cost (see also Table 5-6). Imports increase by less than one-tenth of one percent (approximately $1.3 **m**illion), domestic prices increase by less than one-tenth of one percent, and exports fall by less than one-tenth of one percent (approximately $1.9 **m**illion). For reference, 1997 imports are estimated to have totaled $6.5 **b**illion in value while exports are estimated to have totaled approximately $3.8 **b**illion.

Pursuant to Executive Order 12898, EPA examined the effects of increased prices on low-income consumers. EPA calculated the percentage of average expenditures per consumer unit spent on steel products by income group using the Consumer Expenditure Survey. No category for steel products exists in the survey; instead EPA determined which products were potentially constructed of steel. The items include the following: packaging for processed fruits, processed vegetables, and miscellaneous foods; major appliances; small appliances; and vehicles. See Table 6-2.

There are no significant differences among the percentage of average expenditures for all income groups with the exception of the lowest income group—under $5,000. According to the Consumer Expenditure Survey, this income group spends almost 69 percent of its income on vehicle purchases. This income group, then, may be adversely affected by the rule because the automobile manufacturers may pass on the higher steel cost to the consumers. The effluent limitations guidelines promulgated by EPA lead to less than one-tenth of one percent price increase (see Table 6-1), EPA does not consider low-income populations to be disproportionately affected.

6.1.5 Direct and Community Impacts

There are **no** closures associated with the estimated costs for the promulgated guideline. Hence, there are no direct or community impacts. Because there are no impacts, there are no disproportionately high adverse impacts on minority and low-income populations. That is, EPA has addressed the requirements of Executive Order 12898.

Table 6-1

Market Impacts

Parameter	Final Rule
Pre-tax Annualized Cost (Millions, $1997)	$11
Supply Shift (annualized cost as a percentage of baseline price)	0.02%
Domestic Price	0.02%
Domestic Consumption	-0.02%
Domestic Production	-0.03%
Import Supply	0.02%
Export Demand	-0.05%

Table 6-2

Reported Typical Expenditures by Income-Level for Steel-Containing Products

Item	**Total**	**Less than $5,000**	**$5,000 to $9,999**	**$10,000 to $14,999**	**$15,000 to $19,999**	**$20,000 to $29,999**	**$30,000 to $39,999**	**$40,000 to $49,999**	**$50,000 to $69,999**	**$70,000 and over**
Number of Consumer units	84,115	4,259	8,143	8,469	7,352	12,621	10,123	7,654	11,300	14,193
Average Income Before Taxes	$41,622	$1,888	$7,735	$12,375	$17,464	$24,648	$34,473	$44,289	$58,516	$108,257
Average Income After Taxes	$38,358	$1,738	$7,636	$12,155	$16,951	$23,596	$32,393	$40,890	$53,802	$97,419
Average Expenditures Per Consumer Unit										
Total Average Expenditures:	$37,260	$17,502	$14,838	$19,958	$22,810	$27,941	$33,616	$39,934	$49,376	$73,786
Processed Fruits:	$104	$63	$59	$70	$81	$88	$100	$120	$123	$169
% of Income (after)	0.27%	3.62%	0.77%	0.58%	0.48%	0.37%	0.31%	0.29%	0.23%	0.17%
Processed Vegetables:	$78	$36	$49	$55	$64	$78	$78	$80	$101	$109
% of Income (after)	0.20%	2.07%	0.64%	0.45%	0.38%	0.33%	0.24%	0.20%	0.19%	0.11%
Miscellaneous Foods:	$408	$237	$235	$261	$280	$344	$413	$473	$535	$627
% of Income (after)	1.06%	13.64%	3.08%	2.15%	1.65%	1.46%	1.27%	1.16%	0.99%	0.64%
Major Appliances:	$172	$89	$72	$146	$121	$136	$195	$144	$246	$268
% of Income (after)	0.45%	5.12%	0.94%	1.20%	0.71%	0.58%	0.60%	0.35%	0.46%	0.28%
Small Appliances:	$87	$29	$35	$37	$45	$68	$75	$91	$139	$171
% of Income (after)	0.23%	1.67%	0.46%	0.30%	0.27%	0.29%	0.23%	0.22%	0.26%	0.18%
Vehicle Purchase:	$3,043	$1,193	$829	$1,724	$1,876	$2,411	$2,588	$3,274	$4,664	$5,732
% of Income (after)	7.93%	68.64%	10.86%	14.18%	11.07%	10.22%	7.99%	8.01%	8.67%	5.88%

Source: U.S. Census, Bureau of Labor Statistics, Consumer Expenditure Survey, 1998

6.1.6 National Direct and Indirect Impacts

If a site is projected to close, there are directs effects such as the loss in employment and output at the closed facility. The impacts resonate through the economy. EPA used the Department of Commerce's national final demand multipliers from the Regional Input-Output Modeling System to estimate these effects (see Section 4.3). For the selected options, there are **no** closures, hence, there are no national direct and indirect impacts.

6.1.7 Summary of Impacts on Existing Sources

EPA projects no adverse economic impacts as a result of the promulgated effluent limitations guidelines.

6.2 NEW SOURCE PERFORMANCE STANDARDS (NSPS) AND PRETREATMENT STANDARDS FOR NEW SOURCES (PSNS)

For cokemaking indirect dischargers, EPA evaluated the technologies for PSES 3 but estimated costs for new sources rather than existing sources. EPA deemed PSES 3 as economically unachievable because the estimated costs are projected to result in two site closures (see Section 6.1.1.2 above). EPA then estimated the costs for the PSES 3 technologies but for new sources. Three of eight sites already have biological treatment (i.e., the technology that distinguishes PSES 3 from PSES 1), indicating that it is not a barrier to entry. For the remaining five sites, estimated PSNS costs are equal to or lower than those for PSES 3 (e.g. lower capital costs related to flow reduction, lower O&M costs related to operation of ammonia stills, or both). Based on data from existing sources, the estimated PSNS costs result in no projected closures. Hence, EPA deems it economically achievable for new sources to meet the limitations while the Agency does not consider the same limitations economically achievable for existing sources.

The technology options EPA considered for new sources in the other subcategories are identical to those it considered for existing dischargers. Engineering analysis indicates that the cost of installing pollution control systems during new construction is less than the cost of retrofitting existing facilities.

Because EPA projects the costs for new sources to be less than those for existing sources and limited or no impacts are projected for existing sources, EPA expects no significant economic impacts for new sources. Because EPA projects no impacts for new sources, the regulation cannot be considered a barrier to entry.

6.3 REFERENCES

DOC. 1998. U.S. Census. Bureau of Labor Statistics, Consumer Expenditure Survey, 1998. <http://stats.bls.gov/csx/1998/Standard/income.pdf> downloaded 23 May 2000.